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EARTH OBSERVATORY SATELLITE SYSTEM DEFINITION STUDY (EOS)

PREPARED FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER

IN RESPONSE TO
CONTRACT NAS5-20519

FEB 1975

TRW
SYSTEMS GROUP

ONE SPACE PARK • REDONDO BEACH, CALIFORNIA 90278

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CONTENTS

		Page
1.	INTRODUCTION	1-1
2.	PROBLEM DEFINITION	2-1
	2.1 Missions	2-1
	2.2 Shuttle Application Modes	2-1
	2.3 Assumptions and Groundrules	2-3
3.	METHOD OF EVALUATION	3-1
	3.1 TRW Mission Simulation	3-1
	3.2 Adaptation of EOS Study	3-4
	3.2.1 Maintenance Models	3-4
	3.2.2 Cost Models	3-6
4.	STUDY DATA BASE	4-1
	4.1 Shuttle Data Base	4-1
	4.2 Satellite Data Base	4-2
	4.2.1 Spacecraft	4-2
	4.2.2 Payload	4-8
	4.2.3 Nonreplaceable Elements	4-8
	4.2.4 Spacecraft-Level Fixed Costs	4-8
5.	SIMULATION RESULTS	5-1
	5.1 Shuttle Launch-Only Mode (Expendable)	5-1
	5.2 Conventional Launch Vehicle (Expendable)	5-1
	5.3 Shuttle Launch-And-Resupply Mode	5-3
	5.4 Shuttle Launch-And-Retrieval Mode	5-3
6.	CONCLUSIONS AND RECOMMENDATIONS	6-1
	6.1 Evaluation of Results	6-1
	6.1.1 Effect of Satellite Redundancy	6-4
	6.1.2 Effect of Satellite Maintenance	6-6
	6.1.3 Effect of Conventional Launch Vehicle	6-6
	6.1.4 Effect of Retrieval Versus Resupply	6-8
	6.1.5 Effect of Servicing Policy	6-8
	6.1.6 Effect of Launch Delay	6-9
	6.2 Recommendations for Future Studies	6-9
7.	REFERENCES	7-1

CONTENTS (Continued)

		Page
APPENDIX A	Simulation Model and Computer Program	A-1
APPENDIX B	Representative Mission Simulation for Launch-Only Shuttle Mode	B-1
APPENDIX C	Representative Mission Simulation for Launch-and-Resupply Shuttle Mode	C-1
APPENDIX D	Assessment of Advanced Missions	D-1

ILLUSTRATIONS

		Page
2-1	System Maintenance Modes	2-2
6-1	Mission Costs with 3-Month Launch Delay (10-Year Missions)	6-3
6-2	System Availability with 3-Month Launch Delay	6-3
6-3	Normalized Satellite Cost as a Function of MTTF for Expendable Shuttle Launch	6-5

TABLES

		Page
3-1	Module State Definition	3-3
4-1	Shuttle Costing Parameters	4-1
4-2	Actuation Module Description	4-3
4-3	Attitude Determination Module Description	4-4
4-4	Communication and Data Handling Module Description	4-5
4-5	Solar Array and Drive Module Description	4-6
4-6	Electric Power Module Description	4-7
4-7	Wideband Communications and Data Handling Module Description	4-9
4-8	Five-Band MSS Module Description	4-10
4-9	Nonreplaceable Elements (NRU)	4-11
5-1	Results for Shuttle Launch-Only System Maintenance (10-Year Mission)	5-2
5-2	Effective MTTF from Launch-Only Simulation Data	5-3
5-3	Results for Conventional Launch Vehicle System Maintenance (10-Year Mission)	5-4
5-4	Results for Shuttle Launch-and-Resupply Mode with Baseline Flight Criteria: Serviced on State 6 (10-Year Mission)	5-5
5-5	Results for Shuttle Launch-and-Resupply Mode with Alternate Flight Criteria: Not Serviced on State 6 (10-Year Mission)	5-6
5-6	Results for Shuttle Launch-and-Retrieval Mode with Baseline Flight Criteria: Serviced on State 6 (10-Year Mission)	5-8
5-7	Results for Shuttle Launch-and-Retrieval Mode with Alternate Flight Criterion: No Service on State 6	5-9
5-8	Resupply Simulation Data and Derived Retrieval Data	5-10
6-1	Summary of Cost Data for 10-Year Mission	6-2
6-2	Summary of Launch Cost Data for 10-Year Mission	6-7

1. INTRODUCTION

This report presents the economic aspects of Shuttle application to a representative EOS-type operational mission in the various candidate Shuttle modes: launch, retrieval, and resupply. System maintenance of the same mission capability via a conventional launch vehicle is also provided.

Development of the Space Shuttle is the beginning of an era in which space programs can be planned around a nonexpendable maintenance philosophy. Cost savings can be realized both from launch vehicle reuse and from spacecraft hardware salvage and reapplication. The conceptual and detailed design of the EOS has been carried out with this on-orbit maintenance capability in mind, providing for spacecraft retrieval and/or on-orbit replacement of subsystem modules (Reference 1).

The extent to which the cost-saving potential offered by Shuttle can be realized will depend upon the details of module/spacecraft design, as well as the policy employed in scheduling Shuttle flights. As an example, there is a definite cost tradeoff in selecting the redundancy within spacecraft modules; low redundancy will yield short mean-times-to-failure (MTTFs) and frequent Shuttle flights, while excessive redundancy may cause the spacecraft cost and weight to be unacceptable. Other issues include the desirability of preventive maintenance (e.g., replacing a module which has experienced only noncritical failures), tradeoffs between resupply and retrieval, whether to service in the operational orbit or to deboost for low altitude servicing, and whether to implement a particular mission with a single or with multiple satellites.

The studies documented here are based on application of a sophisticated Monte Carlo mission simulation program developed originally for studies of in-space servicing of a military satellite system via a Shuttle-Tug system (Reference 2). This program, which allows detailed modeling of the spacecraft modules at the component level (e.g., cost, failure rates, redundancy configuration), has been modified to permit evaluation of Shuttle application to low-altitude EOS missions in three modes: launch-only, retrieval, and resupply.

In the course of these studies it has become apparent that this existing mission cycle costing program has features which, when coupled with schedule and fiscal constraints of the EOS system study, limit the types of missions which can be evaluated. These limitations are noted in the appropriate sections of this report and a final section recommends future study tasks which will enhance mission planning. It should be noted, however, that these restrictions have not prevented achieving the objective of this study — that is, a cost comparison of Shuttle application modes for representative EOS operational missions.

The mission simulations performed in the course of the EOS system study have led to the following conclusions:

- Reduced mission cost and increased satellite availability can be gained by increased levels of satellite redundancy
- Shuttle servicing provides significant advantages over an expendable system maintenance approach
- For expendable operation, Shuttle launch is more cost effective than use of a conventional launch vehicle
- Resupply is significantly more cost effective than retrieval
- Preventive maintenance flights (i.e., initiated to prevent loss of deboost capability) improve availability but increase the total mission cost
- Reduced launch delay improves availability but increases total mission cost.

These conclusions are discussed in Section 6, where it is noted that they are dependent on the models and data based used. In particular, the cost algorithm used to assess the EOS program for Shuttle use is a sensitive factor.

2. PROBLEM DEFINITION

2.1 MISSIONS

The study RFP defined a research and development EOS-A mission with a thematic mapper (TM) plus high-resolution pointable imager (HRPI) payload. During the course of the study a variety of alternate operational and R&D payloads have been discussed, including spacecraft with single instruments, tandem (skewed) instruments, redundant instruments, etc. (Reference 3).

The most commonly considered operational instrument has been the 5-band multispectral scanner (MSS), a sensor based upon the ERTS-flown MSS. The basic mission chosen for study of Shuttle servicing is a single satellite having a single 5-band MSS and a compatible wideband communications and data handling (WBCDH) module (the latter including video tape recorders), with the payload redundancy level (within the WBCDH and MSS) considered as a study parameter. Selection of this mission has been motivated by a variety of factors, including:

- Owing to its advanced state of development, definitive reliability and design data is available for the 5-band MSS (Reference 4).
- The relative merits of the Shuttle application modes should not depend strongly upon the specific payload flown.
- A simple mission (i.e., single satellite with a single sensor) will yield data most easily understood; its evaluation is a necessary precursor to study of more complex situations.

Study of alternate missions (e.g., satellites with tandem instruments providing degraded coverage frequency in the event of failure of one instrument; multisatellite systems, where loss of a single satellite yields degraded coverage; and, payloads with advanced instrument payloads) is a suggested future task.

2.2 SHUTTLE APPLICATION MODES

The Space Shuttle can be used to maintain an operational EOS in three distinct ways:

1) Launch Only. The initial satellite is launched via Shuttle. When it fails it is replaced by a new satellite, with the failed spacecraft left in orbit. This mode is equivalent to use of a

conventional launch vehicle, the only difference being in the launch vehicle cost and availability.

2) Launch and Retrieve. The initial satellite is launched via Shuttle. When it fails it is replaced by a new satellite, with the old satellite retrieved from orbit and refurbished on the ground for subsequent reuse.*

3) Launch and Resupply. The initial satellite is launched via Shuttle. When it fails it is repaired in orbit by replacing the appropriate modules using the Shuttle Flight Support System.*

Figure 2-1 illustrates these three system maintenance modes.

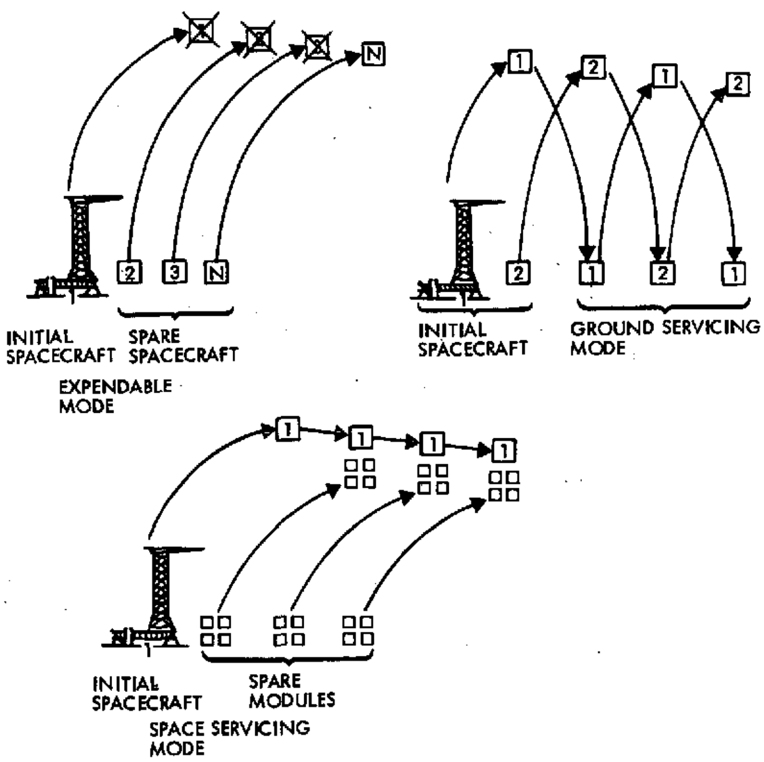

Figure 2-1. System Maintenance Modes

*Resupply and retrieval flights are generally planned prior to ultimate failure of the spacecraft; the servicing logic is delineated in Section 3.2.

2.3 ASSUMPTIONS AND GROUNDRULES

In addition to the models defined in the following section, a number of groundrules have been established for mission tradeoffs. Some of these are obvious decisions, while others suggest areas for future study.

- The spacecraft module designs reported in Reference 1 have been employed. In particular, propulsion and control actuation equipment are in a common module (actuation module).
- All initial Shuttle launches will be to low altitude (100 n mi circular orbit), with insertion into the operational orbit (375 n mi) via spacecraft propulsion. In the expendable launch-only mode all subsequent launches will also be to low altitude.
- Shuttle servicing flights (retrieve or resupply) will be to low altitude, unless the spacecraft has experienced a failure which prevents its deboost to the 100 n mi circular orbit.
- All retrieval flights will include replacement with a new satellite.
- The actuation module will always be replaced on low altitude resupply flights, in order to renew the orbit transfer propellant. On high altitude resupply flights it will be replaced only if it satisfies the replacement criteria applied to other spacecraft modules (Section 3.2).
- A fixed-mission duration by 10 years is used in all runs. The basic outputs of interest are cost per year of system operation and availability percentage.
- Only recurring spacecraft and launch vehicle costs are considered. Ground operation costs and nonrecurring costs are not significantly dependent upon the parameters being traded.
- All equipment failures are on-orbit satellite failures. Shuttle failures, for example, are not considered.
- Following a Shuttle-maintenance flight decision, there is a fixed delay until the flight is actually made; this delay is a parameter of the study. An alternate approach would be to manufacture modules on a prescribed schedule and suffer varying launch delays in cases of inventory depletion; this more refined and detailed model can be considered as a topic for future study.

3. METHOD OF EVALUATION

Mission cycle costing studies have been carried out using the TRW mission simulation evolved during previous studies, modified and enhanced during the EOS system study. This section describes the general characteristics of the mission costing program (described in greater depth in Appendix A) and the manner in which it has been adapted to EOS.

3.1 TRW MISSION SIMULATION

The TRW mission simulation treats Shuttle-serviced satellite systems via a Monte Carlo simulation technique. In its most general form it simulates all phases of a space mission: spacecraft manufacturing, launch vehicle scheduling, Shuttle-spacecraft mating, launch, on-orbit operation, etc. This detailed capability is described in Appendix A.

For the present discussion it is sufficient to consider the manner in which on-orbit operation is treated. The satellite itself is modelled by an input-specified array of space-replaceable units (SRU's) and non-replaceable units (NRU's), where, for EOS, the SRU's correspond to the resuppliable modules (spacecraft and payload) and the single NRU is composed of the nonmodular elements (spacecraft structure, payload support structure, transition ring, adapter, etc.) Each module is represented as a set of component groups, that is, redundancy groups, with each group having an input-specified redundancy configuration and each component within the group having a selectable reliability model (e.g., exponential with MTBF as input data).

To evaluate a specific mission case, a number of runs (typically 100) are made and evaluated statistically. Each run consists of a sequence of events defined by an order of component failures on board the orbiting spacecraft and a corresponding set of maintenance activities. The event sequence for a particular run is established in a random manner by selecting a random number between zero and one for each component and using the inverse of the reliability relationship to establish the random failure time; for an exponential reliability model the time of failure for any component is given by

$$T_f = -\frac{1}{\lambda}\ln R \qquad (1)$$

where R is the randomly selected reliability and λ is the failure rate of that component.

Within the modules (SRU's and NRU's) each component group is classified as one of four types:*

- Class 0. Noncritical. Loss of such a group will endanger neither the mission nor the spacecraft.
- Class 1. Mission Critical. Loss of such a group will abort the mission but will not endanger the satellite.
- Class 2. Transfer Critical. Loss of such a group will prevent orbit transfer, preventing deboost for low altitude servicing, but will not endanger the satellite.
- Class 3. Survival Critical. Loss of such a group will cause loss of the satellite.

Note that failure of a group means fewer components are functional than are required; for example, if three gyros are needed and six are provided (3/6 redundancy), the third gyro failure makes the group one failure away from loss and the fourth gyro failure signals loss of this component group.

The decision to schedule Shuttle maintenance flights and the modules to be replaced (on a resupply flight) are based on the concept of module state defined in Table 3-1. Note that the module state is taken to be the highest (numerically longest) one determined by evaluating each of its constituent component groups according to the definitions in Table 3-1. Similarly, the satellite state is the highest of its module states.

As noted above each run generates a random sequence of events (i.e., component failures). Each event is evaluated, in sequence, to determine if it causes a change in state. When the state of the satellite

*The "transfer critical" class has been introduced specifically for EOS, to allow a meaningful discrimination between high-altitude and low-altitude serviceability.

Table 3-1. Module State Definition

State	Definition
0	No component failures; initial state
1	Component failure in Class 0 group
2	Loss of Class 0 group
3	Unassigned
4	Component failure in Class 1, Class 2 or Class 3 group
5	Class 1 group is one failure away from loss
6	Class 2 group is one failure away from loss
7	Class 1 group is lost
8	Class 3 group is one failure away from loss
9	Class 2 group is lost
10	Class 3 group is lost (loss of satellite)

becomes sufficiently high, a service flight is scheduled. For pre-EOS studies, involving multiple satellites serviceable on the same shuttle flight, the servicing policy was as follows:

- A service flight is initiated due to loss of operation or being one failure away from loss of any spacecraft.
- A replacement flight will replace all SRU's in State 5 or higher on all satellites, if possible within the Shuttle payload weight and volume limit. If not possible, modules are replaced according to the following priority scheme:
  1) Replace all State 5 SRU's on the satellite causing the flight, if this is not possible, replace those with the lowest component group MTBF's (i.e., most likely to fail in the future) in ascending order until the weight or volume limit is reached.
  2) If Shuttle payload capacity permits servicing of additional satellites, scan all satellites for State 5 SRU's to find those most likely to fail in the future. Select such modules in order to ascending MTBF until Shuttle weight or volume limit is reached.

This service policy has been modified for EOS consistent with the added component class and the revised state structure. Note, also, that weight/volume limits are never exceeded for the single satellite EOS system defined in Section 2.1, but could be in a two (or more) satellite system.

The resupply/rework costing model employed for pre-EOS studies has assumed a rework cost which is a specified percentage of the initial module cost. For EOS, a refined model which takes into account knowledge of which components within the module have failed has been programmed.

3.2 ADAPTATION OF EOS STUDY

Application of the TRW mission simulation to EOS system maintenance studies has required alteration of the servicing logic and refinement of the costing model.

3.2.1 Maintenance Models

System maintenance logic can be considered for each of the Shuttle application modes. In general, two issues must be dealt with - when to make a Shuttle flight and what maintenance activities to undertake at that time (for example, what state is employed as a replacement criterion on a resupply flight). Questions of Shuttle payload limits are not an issue for a single satellite system with the orbits and designs defined in Section 2.3 and so will not be considered further (if required the priority logic defined earlier would automatically come into play).

3.2.1.1 Launch-Only Mode

This is the simplest mode to consider. For these evaluations, a replacement flight is scheduled only after failure of the in-orbit satellite to perform its mission due to loss of a component group classified other than Class 0.* Scheduling Shuttle flights prior to spacecraft outage is an optional alternative; however, since the satellite in orbit cannot be retrieved for its "salvage" value in this expendible mode, the primary motivation for survival-based flights is negated, leaving the only gain an increase in availability.

The maintenance action in this mode is replacement of the failed satellite with a new one.

*Operation could continue after failure of certain Class 2 and Class 3 elements (e.g., the hydrazine system). However all such ambiguous component groups are very reliable, making this model a realistic one.

3.2.1.2 Launch-and-Retrieval Mode

When the Shuttle is used for retrieval or on-orbit module replacement (resupply), both high and low orbit servicing must be considered. This is because the GSFC-specified Shuttle cost algorithm (see Section 3.2.2) favors low altitude servicing whenever the state of equipment on board the satellite permits its transfer to and rendezvous with the Shuttle at these altitudes. To consider this factor in the framework of the existing simulation, Class 2 has been defined to be transfer-critical equipment; that is, loss of a Class 2 group will prevent satellite deboost, thus requiring a high-altitude Shuttle service flight.

The baseline Shuttle flight logic, therefore, is to initiate Shuttle service flights whenever a failure results in any one of the following criteria being met (See Table 3-1):

- One failure away from loss of deboost capability (State 6)
- Loss of operational capability (State 7)
- One failure away from loss of satellite (State 8)
- Loss of deboost capability (State 9).

If the satellite is lost (State 10), it is replaced by a new one, with no resupply/retrieval of the old one.

Normally service flights will be made at low altitude, using the on-board satellite to deboost. However, if the satellite is in State 9 the capability to deboost has been lost, and the Shuttle must rendezvous with the satellite at high altitude.*

The baseline logic defined above can force a relatively large number of Shuttle flights, unless Class 2 equipment is made highly redundant. There is a tradeoff between flying early to permit low-altitude servicing a high percentage of the time or waiting to yield fewer flights which are, on the average, more costly due to increased Shuttle costs. This alternate servicing logic has been studied by deletion of Shuttle flights based on State 6.

---

*The alternative of "writing-off" the satellite rather than allowing high flights can be evaluated by reclassifying all Class 2 components as Class 3. This option appears unattractive and has not been evaluated at this time.

When retrieval flights are made, a new satellite is deployed, at the altitude from which the other spacecraft is retrieved (high or low). The elements of the retrieved satellites, modules as well as nonreplaceable units, are reworked and returned to inventory for future application. In this rework all failed components are replaced. The costing algorithms associated with retrieval are defined in Section 3.2.2.

3.2.1.3 Launch-and-Resupply

Shuttle flights for resupply are scheduled on the same basis as retrieval flights, as discussed above. When resupply flights are made, all modules in which there have been any Class 1, 2 or 3 component failures are replaced. Alternate policies (e.g., replace only modules which have a component group one away from loss) may be appealing in weight limited situations but are probably not in this case.

The actuation module, containing the orbit transfer propellant is treated somewhat differently: it must be replaced on all low-altitude resupply flights (in order that the spacecraft can regain its operational altitude); on high-altitude resupply flights its replacement criterion is the same as any other module.

3.2.2 Cost Models

Three distinct cost elements are simulated: launch vehicle costs, initial (new) spacecraft costs, and spacecraft replacement/resupply costs.

3.2.2.1 Shuttle Costs*

The general relationship employed to charge the EOS program for a Shuttle flight is:

$$C_s = K\, W_{EOS} \qquad (2)$$

where W_{EOS} is the weight of the satellite plus the Shuttle flight support system (FSS):

$$W_{EOS} = W_{SAT} + W_{FSS} \qquad (3)$$

* For conventional launch vehicles, the cost is a fixed parameter; see Reference 3.

and K, the cost coefficient, is the ratio of the total Shuttle flight cost to its payload capability to the altitude of interest. The payload capability depends upon altitude and, to a lesser extent, upon whether a rendezvous is required (as in retrieval and resupply). The FSS weight will depend upon whether the on-orbit replacement system (SPMS) is on board. Section 4.1 defines these coefficients for each Shuttle mode and service altitude.

It should be noted that all Shuttle flights are costed assuming a two-way (ascent and descent) trip carrying the same weight. In a launch-only mode, it is assumed that no other program can make use of the additional descent weight capability. All other flights retrieval/replacement and resupply are inherently two-way.

3.2.2.2 New Satellite Costs*

The satellite (observatory) consists of payload modules (SRU's), spacecraft modules (SRU's), and a nonreplaceable unit (NRU) which includes the satellite structure, harnesses, transition ring, interstage adapter, etc. If the satellite consists of J such elements, the total cost of a new satellite is given by

$$C_{SN} = C_{SO} + \sum_{j=1}^{J} C_{jN} \tag{4}$$

where

- C_{jN} is the new cost of the j^{th} element (SRU or NRU)
- C_{SO} is the fixed spacecraft build cost (costs which do not depend upon the module costs).

The new cost of any satellite module is given by:

$$C_{jN} = C_{oj} + k_{1j} \sum_{n=1}^{N} C_n + k_{2j} \sum_{m=1}^{M} C_m \tag{5}$$

*As noted earlier, only recurring satellite costs are considered.

where

C_{jN} is the delivered total cost of module j

C_{oj} is the fixed module build cost (costs which do not depend upon the component costs)

k_{1j} is the cost weighting factor for module j hardware built in house

k_{2j} is the cost weighting factor for module j hardware built outside

N is the total number of components (boxes) built in-house

M is the total number of components (boxes) procured outside

C_n, C_m are the component hardware costs

The data base for the cost model is presented in Section 4.1

3.2.2.3 Satellite Replacement/Resupply Costs

The cost of satellite replacement or resupply can be developed based upon the modelling approach just presented. First note that if a module fails in-orbit the immediate cost of its replacement is equal to C_{jN}. But since the returned module can be refurbished and returned to inventory, the net cost of replacement (resupply or retrieval/replacement) is

$$C_{jR} = \underbrace{\text{(cost of new module)}}_{\substack{\text{Immediate}\\ \text{replacement}\\ \text{cost}}} - \underbrace{\{\text{(cost of new module) - (cost of rework)}\}}_{\substack{\text{Value returned}\\ \text{to inventory}\\ \text{("salvage")}}} \quad (6)$$

Therefore, on a module basis :

$$C_{jR} = \text{cost of rework} \quad (7)$$

And as with a new satellite, the total replacement/resupply cost will be

$$C_{SR} = C_{RO} + \underbrace{\sum_{J_F} C_{jR}}_{\substack{\text{reworked/replaced}\\ \text{modules only}}} \quad (8)$$

where

C_{jR} is the rework cost of the j^{th} element (SRU only for resupply, SRU or NRU for retrieval)

C_{RO} is the fixed spacecraft rework cost (costs which do not depend upon the module costs).

The module rework costs can be developed according to the following equation:

$$C_{jR} = \frac{N_f + M_f}{N+M} \cdot C_{oj} + k_{1j} \sum_{N_f} C_n + k_{2j} \sum_{M_f} C_m \qquad (9)$$

where N_f and M_f are the number of failed components in each category and the summations are carried out only over the reworked elements. Note that $N_f = N$, $M_f = M$ is a complete rework, costing the same as a new module.

4. STUDY DATA BASE

4.1 SHUTTLE DATA BASE

The Shuttle cost coefficient, K, is given by

$$K = \frac{\text{total shuttle launch cost}}{\text{total shuttle weight capability}} = \frac{\$9.8\ M}{W_s} \cdot \frac{1}{\eta} \qquad (10)$$

where \$9.8 M is the total cost of a Shuttle flight (up and down) and η is the Shuttle load factor (here taken as 0.70).

The various coefficients and weights employed in the Shuttle flight cost model presented earlier are presented in Table 4-1.

Table 4-1. Shuttle Costing Parameters

Mode \ Altitude	Low (100 n mi Sun Synchronous)	High (375 n mi Sun Synchronous)	
Launch	W_s = 37,000 lb K = 378.37* W_{FSS} = 1372 lb	W_s = 11,000 lb K = 1272.73* W_{FSS} = 1372 lb	No Rendezvous
Retrieve	W_s = 35,000 lb K = 400.00 W_{FSS} = 1372 lb	W_s = 8,800 lb K = 1590.91 W_{FSS} = 1372 lb	Rendezvous Required
Resupply	W_s = 35,000 lb K = 400.00 W_{FSS} = 2472 lb	W_s = 8,800 lb K = 1590.91 W_{FSS} = 2472 lb	Rendezvous Required

*(K in dollars/lb)

Note that the values shown for K favor low altitude servicing, unless there is a significant accompanying increase in the number of Shuttle flights and/or the cost of the spacecraft.

4.2 SATELLITE DATA BASE

As modelled in the mission simulation, the satellite consists of five replaceable spacecraft modules; two replaceable payload modules, and a single nonreplaceable unit. The following sections present the detailed cost, weight, redundancy, and reliability models employed.

4.2.1 Spacecraft

The spacecraft modules are defined in Tables 4-2 through 4-6 for five redundancy configurations:

- Minimum — minimum redundancy necessary to ensure no single-failure preventing retrieval or resupply.
- Variant 1 — limited additional redundancy.
- Variant 2 — still more redundancy.
- Nominal — most electronics made standby redundant; "typical" redundancy level for long-life spacecraft.
- Growth — added replication of Class 2 items in order to reduce the frequency of servicing flights.

Within the tables several notational conventions require explanation:

1) λ is the number of failures per hour (all components are modelled with exponential reliability)

2) Source 1 is a "make", 2 a "buy".

3) S indicates standby redundancy, A active redundancy, and AS indicates one actively redundant unit with other redundant components in standby.

Note that the weights shown are generally a function of the Shuttle application mode. However, for all but the actuation module, the launch-only weight and the retrieval weight are the same.

The mission simulation, as presently configured, has no provisions for scheduling flights based on component degradation. This omission is of significance for EOS in the case of the solar array due to its high cost and high reliability (i.e., no replacement due to random failure is likely). The implications of this factor are complicated further by the fact that an array design providing a particular operational life will allow spacecraft retrieval/resupply at times well in excess of this time due to lower nonoperational power requirements. The results presented below should be evaluated noting that array degradation has not been considered.

Table 4-2. Actuation Module Description

Components				Redundancy Configurations									
				Minimum		Variant 1		Variant 2		Nominal		Growth	
Name	λ(x10⁹)	Cost ($K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	24.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	18.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Propulsion thermal control	10	11.5	1	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Roll reaction wheel	150	52.0	2	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Pitch reaction wheel	150	52.0	2	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Yaw reaction wheel	150	52.0	2	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Roll wheel electronics	3235	26.0	1	1/1	1	1/2 S	1	1/2 S	1	1/2 S	1	1/2 S	1
Pitch wheel electronics	3235	26.0	1	1/1	1	1/2 S	1	1/2 S	1	1/2 S	1	1/2 S	1
Yaw wheel electronics	3235	26.0	1	1/1	1	1/2 S	1	1/2 S	1	1/2 S	1	1/2 S	1
Roll magnetic torquer	100	8.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Pitch magnetic torquer	100	8.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Yaw magnetic torquer	100	8.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Magnetic torquer electronics	2700	25.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/2 S	1
DIU/SCU	4632	42.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2	1/3 S	2
Cold gas system	12	245.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Hydrazine system	342	175.0	1	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Harness	0	16.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch-only weight (lb)			569		591		600		605		624	
	Retrieval weight (lb)			1006		1038		1052		1060		1086	
	Resupply weight (lb)			1215		1248		1261		1270		1296	

C_o = \$45.0K; k_1 = 1.32; k_2 = 1.50

Table 4-3. Altitude Determination Module Description

Components				Redundancy Configurations									
				Minimum		Variant 1		Variant 2		Nominal		Growth	
Name	λ (x10^9)	Cost ($K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	19.6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	18.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Gyro reference assembly	16682	80.0	2	3/3	2	3/4 S	2	3/4 S	2	3/6 S	2	3/6 S	2
Star tracker	5256	69.0	2	2/2	1	2/3 S	1	2/3 S	1	2/3 S	1	2/3 S	1
Magnetometer	1400	20.0	2	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Sun sensor*	232	44.0	2	1/1	0	1/1	0	1/1	0	1/1	0	1/1	0
Transfer assembly A	9500	27.5	1	1/1	2	1/2 S	2	1/2 S	2	1/2 S	2	1/3 S	2
Transfer assembly B	9500	27.5	1	1/1	1	1/2 S	1	1/2 S	1	1/2 S	1	1/2 S	1
Safe mode electronics*	348	7.0	1	1/1	0	1/1	0	1/1	0	1/1	0	1/1	0
Power conditioning	2500	25.0	1	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3
DIU/SIU	4632	56.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2	1/3 S	2
Harness	0	16.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch-only weight (lb)			172.7		209.5		213.9		233.8		251.3	
	Retrieval weight (lb)			172.7		209.5		213.9		233.8		251.3	
	Resupply weight (lb)			196.1		232.9		237.3		257.2		274.7	

*The sun sensor and safe mode electronics are modelled as Class O because they will not be employed continuously until other equipment malfunctions have caused scheduling of a maintenance flight.

C_o = \$90.K; k_1 = 1.29; k_2 = 1.12

Table 4-4. Communication and Data Handling Module Description

Components				Redundancy Configurations									
				Minimum		Variant 1		Variant 2		Nominal		Growth	
Name	$\lambda(x10^9)$	Cost ($K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	19.6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	13.9	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Omni antenna system	20	20.0	2	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Transmitter	1708	43.0	2	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Receiver	4021	65.0	2	1/1	2	1/1	2	1/1	2	1/2 A	2	1/3AS	2
Diplexer	120	32.0	2	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Demod/decoder	463	30.0	1	1/1	2	1/1	2	1/1	2	1/2 A	2	1/3AS	2
Bus controller	3652	20.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2	1/3 S	2
Baseband assembly	1147	12.0	1	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Power conditioning	2500	25.0	1	1/1	2	1/1	2	1/2 A	2	1/2 A	2	1/3AS	2
Combiner/switch	240	6.5	2	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
Central processor	7000	45.0	2	1/1	2	1/2 S	2	1/2 S	2	1/2 S	2	1/3 S	2
Memory module	3429	35.0	2	2/2	2	2/3 S	2	2/3 S	2	2/3 S	2	2/4 S	2
DIU/SCU	3416	22.0	1	1/1	2	1/1	2	1/2 S	2	1/2 S	2	1/3 S	2
Harness	0	15.0	1	1/1	2	1/1	2	1/1	2	1/1	2	1/1	2
	Launch-only weight (lb)			146.4		157.7		165.2		170.7		197.8	
	Retrieval weight (lb)			146.4		157.7		165.2		170.7		197.8	
	Resupply weight (lb)			169.8		181.1		188.6		194.2		221.3	

C_o = \$90.0K; k_1 = 1.29; k_2 = 1.12

Table 4-5. Solar Array and Drive Module Description

Components				Redundancy Configurations									
				Minimum		Variant 1		Variant 2		Nominal		Growth	
Name	$\lambda (x10^9)$	Cost ($K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	92.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	12.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Array drive	250	45.0	1	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3
Array drive electronics	4537	30.0	1	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/3 S	3
DIU/SCU	3464	22.0	1	1/1	2	1/1	2	1/1	2	1/2 S	2	1/3 S	2
Power conditioning	850	25.0	1	1.2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/3 S	3
Array	0	528.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Harness	0	10.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3

	Minimum	Variant 1	Variant 2	Nominal	Growth
Launch-only weight (lb)	194.6	194.6	194.6	199.0	208.0
Retrieval weight (lb)	194.6	194.6	194.6	199.0	208.0
Resupply weight (lb)	233.3	233.3	233.3	237.7	246.7

C_o = \$25.0K; k_1 = 1.28; k_2 = 1.11

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Table 4-6. Electric Power Module Description

Components				Redundancy Configurations									
				Minimum		Variant 1		Variant 2		Nominal		Growth	
Name	$\lambda (x10^9)$	Cost ($K)	Source	Red.	Class	Red.	Class	Red.	Class	Red.	Class	Red.	Class
Structure	0	19.6	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
Module thermal control	10	18.0	1	1/1	1	1/1	1	1/1	1	1/1	1	1/1	1
Power conditioning	2500	25.0	1	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/3 S	3
DIU/SCU	4580	39.0	1	1/1	1	1/1	1	1. 2 S	1	1/2 S	1	1/2 S	1
Power control unit	800	65.0	1	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3	1/2 S	3
Batteries	570	28.8	2	2/3 A	3	2/3 A	3	2/3 A	3	2/3 A	3	2/3 A	3
Harness	0	17.0	1	1/1	3	1/1	3	1/1	3	1/1	3	1/1	3
	Launch-only weight (lb)			404.6		404.6		416.7		416.7		426.9	
	Retrieval weight (lb)			404.6		404.6		416.7		416.7		426.9	
	Resupply weight (lb)			428.0		428.0		440.1		440.1		450.3	

C_o = \$30.0K; k_1 = 1.29; k_2 = 1.12

4.2.2 Payload

The two payload modules are defined in Tables 4-7 and 4-8 for two configurations, one more redundant than the other. Note that the video type recorders are included within the wideband communications and data handling module.

4.2.3 Nonreplaceable Elements

Nonreplaceable elements are contained in a single NRU defined in Table 4-9.

4.2.4 Spacecraft-Level Fixed Costs

Spacecraft-level fixed costs include such items as: program management; configuration management; system engineering; electrical design integration; mechanical design integration; reliability and safety; parts, materials and processes; quality assurance; integration; and environmental test. They enter into the total cost of a spacecraft (new or refurbished) as shown in equations (4) and (8). Values used during this study are:

- C_{So} = \$0.496 M for launch-only and retrieval cases
- C_{So} = \$0.645 M for resupply cases*
- C_{Ro} = \$1.50 M for retrieval cases
- C_{Ro} = \$0.065 M for resupply cases.

For new satellites C_{So} has been arrived at with detailed cost analysis. The resupply value of C_{Ro} includes the costs of module handling during Shuttle payload insertion, etc. The retrieval value of C_{Ro} includes checkout and refurbishment of all spacecraft and payload modules to detect and eliminate contamination and damage caused by the Shuttle return environment.

*Incremental \$150 K is added spacecraft cost to provide on-orbit servicing capability (actually part of the NRU, but included here as a convenience).

Table 4-7. Wideband Communications and Data Handling Module Description

Components				Payload Configuration			
				A		B	
Name	$\lambda(\times 10^9)$	Cost ($K)	Source	Red.	Class	Red.	Class
High-speed multiplexer	76	3.7	1	1/1	1	1/1	1
Data processor	1475	72.0	1	1/1	1	1/2 S	1
Power amplifier	370	18.1	1	1/1	1	1/2 S	1
Antenna	104	5.1	1	1/1	1	1/1	1
Data channels	38	1.9	1	5/6 A	1	5/6 A	1
Video tape recorder	5500	400.0	2	1/2 S	1	1/3 S	1
		Launch-Only weight (lb)		240		326	
		Retrieval weight (lb)		240		326	
		Resupply weight (lb)		329		415	

$C_o = \$30.0K$; $k_1 = 1.29$; $k_2 = 1.12$

Table 4-8. Five-band MSS Module Description

Components				Payload Configuration			
				A		B	
Name	$\lambda(x10^9)$	Cost ($K)	Source	Red.	Class	Red.	Class
Multiplexer, etc.	4810	712.0	2	1/1	1	1/2 S	1
Band 1 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 2 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 3 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 4 channels	757	111.0	2	4/6 A	1	4/6 A	1
Band 5	2172	324.0	2	1/1	1	1/1	1
	Launch-Only weight (lb)			210		232	
	Retrieval weight (lb)			210		232	
	Resupply weight (lb)			276		298	

$C_o = \$30.0K$; $k_1 = 1.29$; $k_2 = 1.12$

Table 4-9. Nonreplaceable Elements (NRU's).

Components				Configuration	
Name	$\lambda(x10^9)$	Cost ($K)	Source	Red.	Class
Spacecraft structure	0	88.9	1	1/1	2
Payload structure	0	287.0	1	1/1	1
Transition ring	0	7.6	1	1/1	2
Adapter	0	25.2	1	1/1	1
Bus mechanisms	0	16.1	1	1/1	2
Spacecraft thermal control	0	118.0	1	1/1	1
Payload thermal control	0	233.0	1	1/1	1
Spacecraft harness	0	10.0	1	1/1	2
Payload harness	0	10.0	1	1/1	1
	Launch-Only weight (lb)			506.1	
	Retrieval weight (lb)			506.1	
	Resupply weight (lb)			593.9	

C_o = \$60.0K ; k_1 = 1.29 ; k_2 = 1.11

*Applies to all spacecraft and payload configurations

5. SIMULATION RESULTS

Simulation results are presented in this section for each of the three Shuttle modes, as well as results for conventional launch vehicles. Note that each case shown represents 100 Monte Carlo mission simulations. These results are evaluated in Section 6.

5.1 SHUTTLE LAUNCH-ONLY MODE (EXPENDABLE)

Simulation data for use of the Shuttle in the expendable mode are presented in Table 5-1 for six satellite designs (spacecraft-payload combinations) and two values of Shuttle launch delay time.

This data, based on satellite failures prior to replacement, can be used to estimate the mean-time-to-failure (MTTF) of each design:

$$\mathrm{MTTF} = \frac{T}{N - 1} - D \tag{11}$$

where T is the mission duration (120 mos), N is the total number of launches (one being the initial launch), and D is the launch delay.

Table 5-2 shows the results of such computations for each of the six satellite configurations simulated, showing good agreement with analyses of similar configurations undertaken early in the study.

5.2 CONVENTIONAL LAUNCH VEHICLE (EXPENDABLE)

Data for system maintenance via a conventional launch vehicle can be developed from Table 5-1 by noting that the number of flights will be unaffected by the launch vehicle used if all other factors are unchanged.* Such results are presented in Table 5-3 for an assumed launch cost of $5.5 million; of course, the data can be adjusted to consider any appropriate launch vehicle.

*There are some other differences (e.g., in the actuation module); however, these have a relatively minor effect on the outcome.

Table 5-1. Results for Shuttle Launch-Only System Maintenance (10 Year Mission)

Satellite* Design	Launch Delay (months)	Percent Availability	No. of Flights	Cost/Satellite ($M)	Cost/Launch ($M)	Total Cost ($M)
MIN-A	3	75.1	10.84	11.04	1.443	135.3
VAR1-A	3	87.4	5.95	11.46	1.470	76.9
VAR2-A	3	90.7	4.66	11.73	1.482	61.6
NOM-A	3	93.9	3.41	12.13	1.496	46.5
NOM-B	3	95.3	2.87	13.49	1.537	43.1
GRO-B	3	96.0	2.54	14.22	1.568	40.1
MIN-A	1	89.5	13.49	11.04	1.443	168.4
VAR1-A	1	95.3	6.60	11.46	1.470	85.3
VAR2-A	1	96.5	5.13	11.73	1.482	67.8
NOM-A	1	97.9	3.49	12.13	1.496	47.6
NOM-B	1	98.3	3.06	13.48	1.537	46.0
GRO-B	1	98.8	2.48	14.22	1.568	39.2

*For example, NOM-A is the nominal spacecraft design in combination with the A payload configuration (see Section 4).

Table 5-2. Effective MTTF from Launch-Only Simulation Data

Satellite Design	Launch Delay (months)	No. of Flights	MTTF (months)	Average MTTF (months)
MIN-A	3	10.84	9.2	8.9
MIN-A	1	13.49	8.6	
VAR1-A	3	5.95	21.2	20.8
VAR1-A	1	6.60	20.4	
VAR2-A	3	4.66	29.8	28.9
VAR2-A	1	5.13	28.1	
NOM-A	3	3.41	46.8	47.0
NOM-A	1	3.49	47.2	
NOM-B	3	2.87	61.2	59.3
NOM-B	1	3.06	57.3	
GRO-B	3	2.54	74.9	77.5
GRO-B	1	2.48	80.1	

5.3 SHUTTLE LAUNCH-AND-RESUPPLY MODE

Simulation results for the resupply maintenance mode are presented in Table 5-4 for the baseline servicing logic, which schedules a Shuttle flight when a failure causes State 6 to occur (or States 7, 8, or 9). Table 5-5 shows equivalent data for the option of not servicing bases on State 6.

5.4 SHUTTLE LAUNCH-AND-RETRIEVAL MODE

Data for retrieval maintenance has been derived from the resupply simulation data summarized above. Because the simulated resupply

Table 5-3. Results for Conventional Launch Vehicle System Maintenance (10 Year Mission)

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights	Cost/Satellite ($M)	Cost/Launch ($M)	Total Cost ($M)
MIN-A	3	75.1	10.84	11.04	5.5	179.3
VAR1-A	3	87.4	5.95	11.46	5.5	100.9
VAR2-A	3	90.7	4.66	11.73	5.5	80.3
NOM-A	3	93.9	3.41	12.13	5.5	60.1
NOM-B	3	95.3	2.87	13.49	5.5	54.5
GRO-B	3	96.1	2.54	14.22	5.5	50.1
MIN-A	1	89.5	13.49	11.04	5.5	223.1
VAR1-A	1	95.3	6.60	11.46	5.5	111.9
VAR2-A	1	96.5	5.13	11.73	5.5	88.4
NOM-A	1	97.9	3.49	12.13	5.5	61.5
NOM-B	1	98.3	3.06	13.48	5.5	58.1
GRO-B	1	98.8	2.48	14.22	5.5	48.9

Table 5-4. Results for Shuttle Launch-and-Resupply Mode with Baseline Flight Criteria: Serviced on State 6 (10 Year Mission)

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights			Total Cost ($M)
			High	Low	Total	
MIN-A	3	72.8	7.76	5.88	13.64	57.79
VAR1-A	3	89.9	2.55	9.24	11.79	41.34
VAR2-A	3	94.5	1.00	9.95	10.95	34.99
NOM-A	3	96.8	0.12	8.32	8.44	28.94
NOM-B	3	97.8	0.07	8.27	8.34	30.35
GRO-B	3	98.0	0.08	3.17	3.25	22.40
MIN-A	1	89.3	9.14	6.29	15.43	63.98
VAR1-A	1	96.3	2.88	9.69	12.57	42.87
VAR2-A	1	98.0	1.18	11.35	12.53	37.87
NOM-A	1	98.9	0.11	8.66	8.77	29.72
NOM-B	1	99.2	0.09	8.78	8.87	31.02
GRO-B	1	99.3	0.11	3.46	3.57	23.07

Table 5-5. Results for Shuttle Launch-and-Resupply Mode with Alternate Flight Criteria: Not Serviced on State 6 (10 Year Mission)

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights			Total Cost ($M)
			High	Low	Total	
MIN-A	3	72.8	7.76	5.88	13.64	57.79
VAR1-A	3	86.0	3.85	4.01	7.86	39.46
VAR2-A	3	89.5	2.96	3.45	6.41	34.70
NOM-A	3	94.2	0.71	3.84	4.55	24.77
NOM-B	3	95.6	0.84	2.90	3.74	25.13
GRO-B	3	96.6	0.66	1.96	2.62	23.83
MIN-A	1	89.3	9.14	6.29	15.43	63.98
VAR1-A	1	94.9	4.42	3.97	8.39	42.11
VAR2-A	1	96.6	2.84	3.37	6.21	33.31
NOM-A	1	98.0	0.79	3.97	4.76	25.69
NOM-B	1	98.4	0.91	2.97	3.88	26.07
GRO-B	1	98.8	0.59	2.15	2.74	23.57

philosophy replaces any modules in which there has been any component failure, the reliability of the satellite is restored to unity on each flight, equivalent to that of the new satellite which would replace a retrieved one. Thus, the flight statistics for retrieval will be the same as those for resupply, allowing computation of expected mission cost based on:

- The cost of launches from the Shuttle launch cost equation (Section 3.2.2.1) and data base (Section 4.1), used in combination with the satellite weights (from Section 4.2.1 data) and the high/low launch statistics (Tables 5-4 and 5-5).
- The cost of new satellites (the initial one and those required to replace any which are lost), based on the cost data of Section 4.2.1.
- The cost of satellite rework which can be derived from the resupply rework costs by noting the number of service flights made and adjusting for the difference in C_{Ro} (Section 4.2.4).

Tables 5-6 and 5-7 show the derived retrieval mission cost data for the two service flight criteria considered.* Table 5-8 presents the cost details for the two Shuttle servicing modes.

*The mission simulation presently schedules retrieval flights based only on loss of a component group in a nonreplaceable unit (NRU). Thus, only terminal failure cases can be simulated (by making all modules NRU's). Incorporation of more sophisticated retrieval logic is under consideration as a future development.

Table 5-6. Results for Shuttle Launch-and-Retrieval Mode with Baseline Flight Criteria: Serviced on State 6 (10 Year Mission)

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights			Total Cost ($M)
			High	Low	Total	
MIN-A	3	72.8	7.76	5.88	13.64	94.64
VAR1-A	3	89.9	2.55	9.24	11.79	63.25
VAR2-A	3	94.5	1.00	9.95	10.95	52.65
NOM-A	3	96.8	0.12	8.32	8.44	40.27
NOM-B	3	97.8	0.07	8.27	8.34	41.78
GRO-B	3	98.0	0.08	3.17	3.25	25.45
MIN-A	1	89.3	9.14	6.29	15.43	106.76
VAR1-A	1	96.3	2.88	9.69	12.57	66.95
VAR2-A	1	98.0	1.18	11.35	12.53	58.65
NOM-A	1	98.9	0.11	8.66	8.77	41.57
NOM-B	1	99.2	0.09	8.78	8.87	43.59
GRO-B	1	99.3	0.11	3.46	3.57	26.68

Table 5-7. Results for Shuttle Launch-and-Retrieval Mode with Alternate Flight Criterion: No Service on State 6

Satellite Design	Launch Delay (months)	Percent Availability	No. of Flights			Total Cost ($M)
			High	Low	Total	
MIN-A	3	72.8	7.76	5.88	13.64	94.64
VAR1-A	3	86.0	3.85	4.01	7.86	57.34
VAR2-A	3	89.5	2.96	3.45	6.41	48.29
NOM-A	3	94.2	0.71	3.84	4.55	30.72
NOM-B	3	95.6	0.84	2.90	3.74	30.21
GRO-B	3	96.6	0.66	1.96	2.62	28.28
MIN-A	1	89.3	9.14	6.29	15.43	106.76
VAR1-A	1	94.9	4.42	3.97	8.39	61.74
VAR2-A	1	96.6	2.84	3.37	6.21	46.58
NOM-A	1	98.0	0.79	3.97	4.76	31.94
NOM-B	1	98.4	0.91	2.97	3.88	31.25
GRO-B	1	98.8	0.59	2.15	2.74	26.30

Table 5-8. Resupply Simulation Data and Derived Retrieval Data

Service Criterion	Launch Delay	Satellite Design	Percent Avail.	Number of Launches			Resupply Costs				Retrieval Costs			
				High	Low	Total	Launch	Sat. Equip.	SRU Rework	Total	Launch	Sat. Equip.	SRU Rework	Total
Baseline: States 6 7 8 9	3 mos	MIN-A	72.8	7.76	5.88	13.64	43.46	11.74	2.59	57.79	62.39	11.59	20.66	94.64
		VAR1-A	89.9	2.55	9.24	11.79	26.85	12.08	2.41	41.34	33.48	11.93	17.84	63.25
		VAR2-A	94.5	1.00	9.95	10.95	20.70	12.00	2.29	34.99	24.25	11.85	16.55	52.65
		NOM-A	96.8	0.12	8.32	8.44	14.60	12.28	2.06	28.94	15.40	12.13	12.74	40.27
		NOM-B	97.8	0.07	8.27	8.34	14.27	13.90	2.18	30.35	15.35	13.75	12.68	41.78
		GRO-B	98.0	0.08	3.17	3.25	6.34	14.51	1.55	22.40	6.33	14.36	4.76	25.45
	1 mo	MIN-A	89.3	9.14	6.29	15.43	50.21	11.19	2.58	63.98	72.43	11.04	23.29	106.76
		VAR1-A	96.3	2.88	9.69	12.57	28.91	11.61	2.35	42.87	36.54	11.46	18.95	66.95
		VAR2-A	98.0	1.18	11.35	12.53	23.53	11.88	2.43	37.87	27.94	11.73	18.98	58.65
		NOM-A	98.9	0.11	8.66	8.77	15.07	12.52	2.13	29.72	15.95	12.37	13.25	41.57
		NOM-B	99.2	0.09	8.78	8.87	15.18	13.63	2.21	31.02	16.41	13.48	13.50	43.39
		GRO-B	99.3	0.11	3.46	3.57	7.02	14.37	1.68	23.07	7.09	14.22	5.37	26.68
Alternate: States 7 8 9	3 mos	MIN-A	72.8	7.76	5.88	13.64	43.46	11.74	2.59	57.79	62.39	11.59	20.66	94.64
		VAR1-A	86.0	3.85	4.01	7.86	25.14	12.08	2.24	39.46	33.38	11.93	12.03	57.34
		VAR2-A	89.5	2.96	3.45	6.41	20.49	12.23	1.98	34.70	26.51	12.08	9.70	48.29
		NOM-A	94.2	0.71	3.84	4.55	10.63	12.40	1.74	24.77	11.65	12.25	6.82	30.72
		NOM-B	95.6	0.84	2.90	3.74	9.87	13.63	1.63	25.13	11.17	13.48	5.56	30.21
		GRO-B	96.6	0.66	1.96	2.62	8.06	14.37	1.40	23.83	8.34	14.22	3.72	28.28
	1 mo	MIN-A	89.3	9.14	6.29	15.43	50.21	11.19	2.58	63.98	72.43	11.04	23.29	106.76
		VAR1-A	94.9	4.42	3.97	8.39	28.03	11.93	2.15	42.11	37.25	11.78	12.71	61.74
		VAR2-A	96.6	2.84	3.37	6.21	19.59	11.88	1.84	33.31	25.53	11.73	9.32	46.58
		NOM-A	98.0	0.79	3.97	4.76	11.42	12.40	1.87	25.69	12.44	12.25	7.25	31.94
		NOM-B	98.4	0.91	2.97	3.88	10.60	13.77	1.70	26.07	11.81	13.62	5.82	31.25
		GRO-B	98.8	0.59	2.15	2.74	7.81	14.37	1.39	23.57	8.19	14.22	3.89	26.30

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6. CONCLUSIONS AND RECOMMENDATIONS

6.1 EVALUATION OF RESULTS

Table 6-1 summarizes the mission cost data for all cases presented in the preceding section. These results are approximated graphically by the fitted-curves shown in Figure 6-1, where the correspondence between MTTF and satellite design is given in Table 5-2.

The other mission parameter of interest is the system availability (that is, the percentage of mission time during which the system is operational). Figure 6-2 shows availability for one data set (3-month launch delay) as a function of satellite design as characterized by MTTF.

This summary data leads to several fundamental conclusions:

a) Reduced mission cost and increased availability can be gained by increased levels of satellite redundancy, so long as the increase in MTTF does not produce a marked increase in satellite hardware cost.

b) Shuttle servicing provides significant advantages (reduced cost, increased availability) over an expendable system maintenance approach.

c) For expendable operation, Shuttle launch is much less expensive than use of a (low cost) conventional launch vehicle.

d) For the particular service policies considered, the resupply mode of Shuttle use is more cost effective than retrieval and provides the same levels of availability.

e) The alternate servicing logic is generally less expensive than the baseline servicing logic, but provides lower availability.

f) A decrease in the Shuttle launch delay will increase availability, but with an accompanying increase in mission costs.

The dependence of these conclusions upon the simulation models and data base employed should be stressed. The following paragraph considers each of the above conclusions from this and other points of view.

Table 6-1. Summary of Cost Data for 10 Year Mission

Launch Delay (months)	Satellite Design	Total Mission Costs ($M)					
		Expendable		Resupply		Retrieval	
		Conventional Launch Vehicle	Shuttle Launch	Baseline Service	Alternate Service	Baseline Service	Alternate Service
3	MIN-A	179.3	135.3	57.8	57.8	94.6	94.6
3	VAR1-A	100.9	76.9	41.3	39.5	63.3	57.3
3	VAR2-A	80.3	61.6	35.0	34.7	52.7	48.3
3	NOM-A	60.1	46.5	28.9	24.8	40.3	30.7
3	NOM-B	54.5	43.1	30.4	25.1	41.8	30.2
3	GRO-B	50.1	40.1	22.4	23.8	25.5	28.3
1	MIN-A	223.1	168.4	64.0	64.0	106.8	106.8
1	VAR1-A	111.9	85.3	42.9	42.1	67.0	61.7
1	VAR2-A	88.4	67.8	37.9	33.3	58.7	46.6
1	NOM-A	61.5	47.6	29.7	25.7	41.6	31.9
1	NOM-B	58.1	46.0	31.0	26.1	43.6	31.3
1	GRO-B	48.9	39.2	23.1	23.6	26.7	26.3

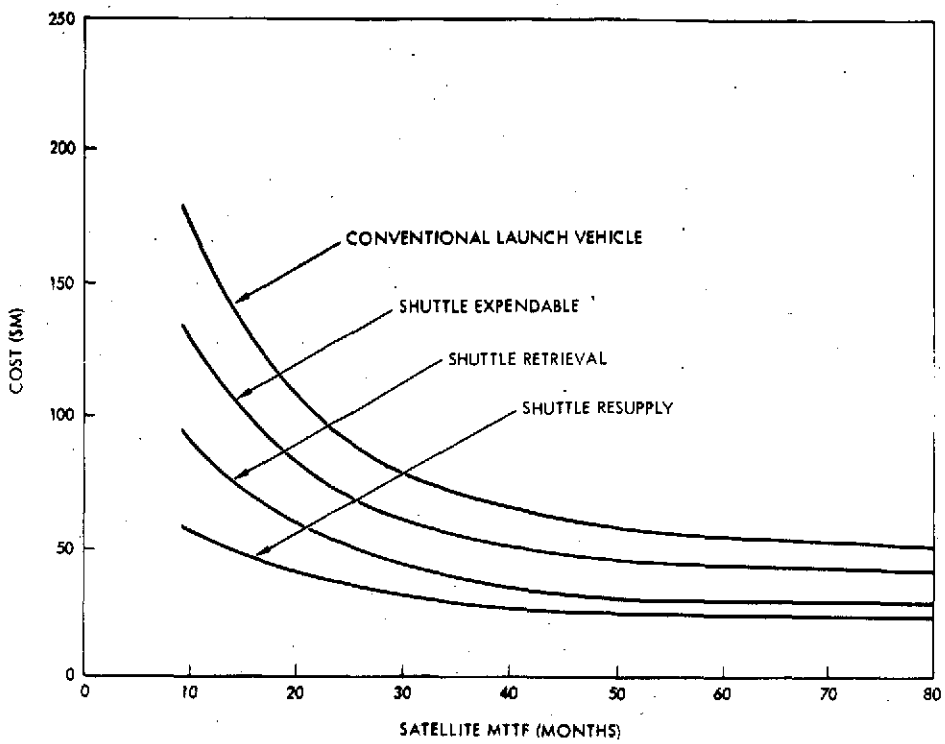

Figure 6-1. Mission Costs with 3-Month Launch Delay (10-Year Missions)

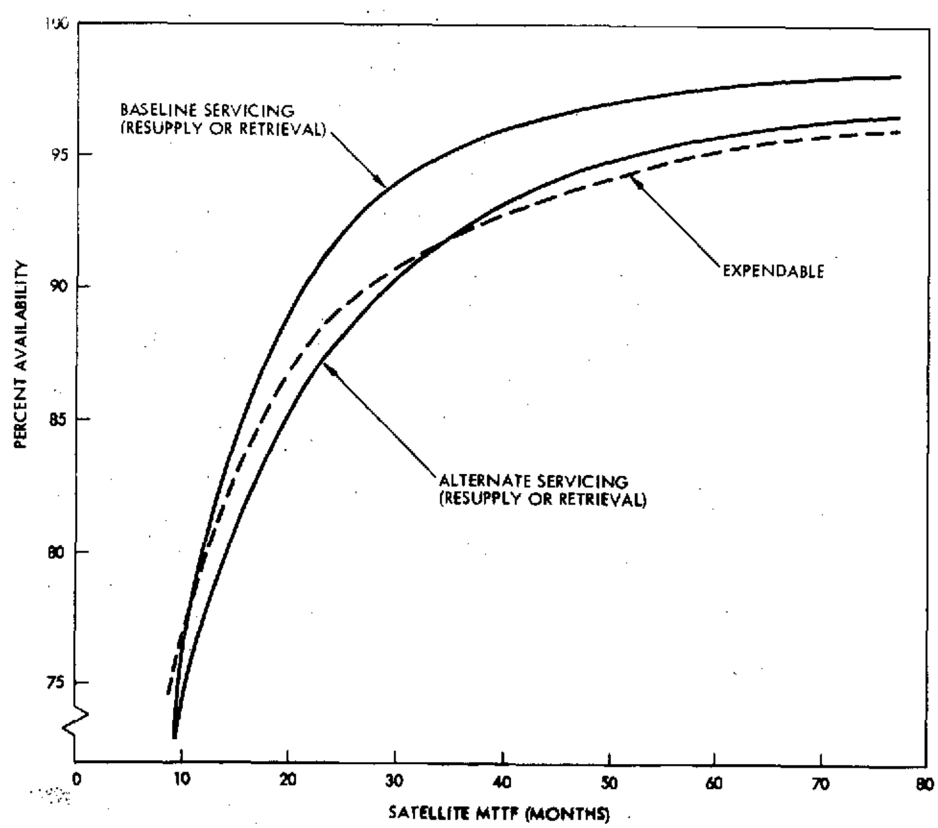

Figure 6-2. System Availability with 3-Month Launch Delay

6.1.1 Effect of Satellite Redundancy

As demonstrated conclusively by the results for all system maintenance modes, increasing spacecraft redundancy at the black-box level can have a salutary effect upon both total mission costs and system availability. This trend occurs because relatively large MTTF increases are attained via relatively small increases in satellite cost, thus decreasing the number of launches required.

Figure 6-3 shows this trend in satellite costs, based on data presented in Tables 5-1 and 5-2. The one "bump" in the otherwise smooth curve is due to the NOM-B (nominal spacecraft with payload B) configuration. This discontinuity manifests itself in the detailed resupply/ retrieval mission cost data (Table 6-1) by a similar phenomenon: in the nonexpendable cases there is a consistent increase in mission cost from NOM-A to NOM-B even though the average number of launches never increases.

This result shows the effect of a significant satellite hardware cost increase without a consistent increase in satellite life. In this case the cost increase is probably in error due to the modeling of the payload elements; in other instances (e.g., increase in spacecraft redundancy beyond the growth configuration) this same situation can occur.*

The fact that large increases in satellite MTTF can be achieved at low cost is not surprising, considering the complexity of the basic spacecraft. However, further increases will cost more, suggesting an eventual upturn in mission cost vs. MTTF curves.

The question of design life must also be considered. The mission simulation as now programmed is unable to treat degradation, a factor

*Cost data to the level of the redundancy blocks was unavailable for the payload elements. The total cost of the basic designs was, therefore, spread in proportion to the block failure bits (Tables 4-7 and 4-8). The costs of the redundant configuration were then computed on the basis of these block costs and are probably excessive.

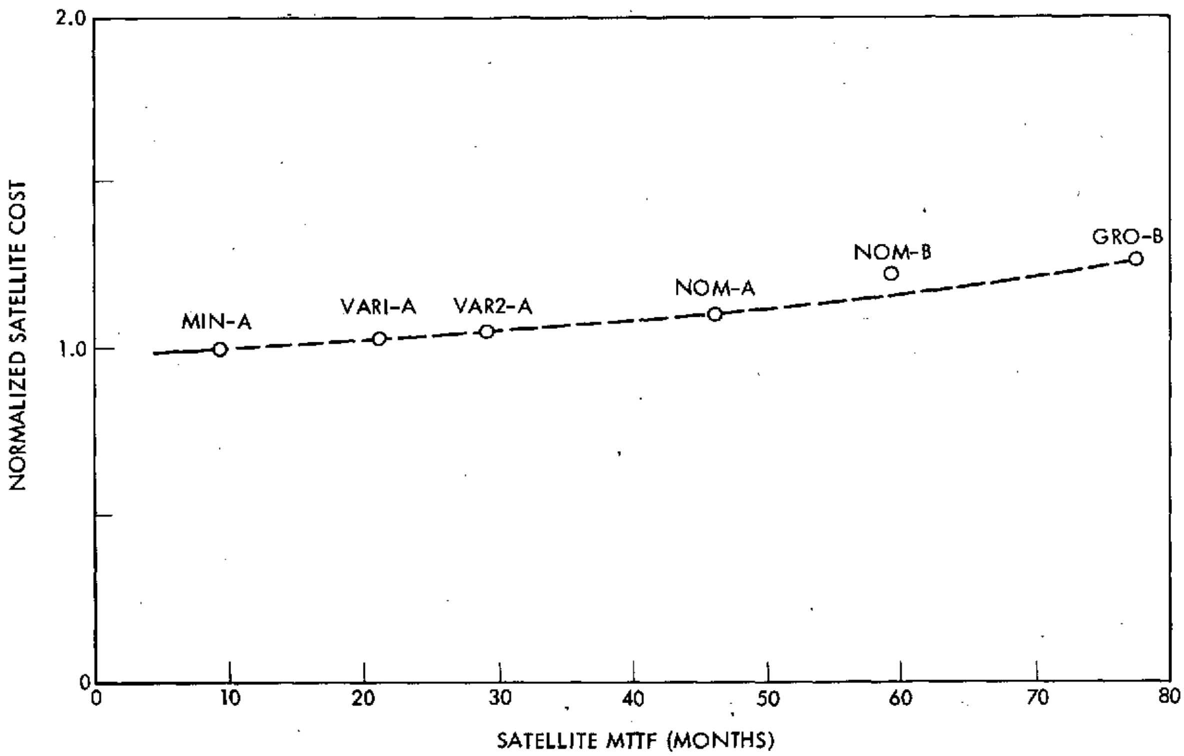

Figure 6-3. Normalized Satellite Cost as a Function of MTTF for Expendable Shuttle Launch

of significance with solar array cells, batteries, etc. For life-limited designs the mean-mission-duration (MMD) is a good measure of satellite life:

$$MMD(T) = \int_0^T R(t)\, dt \tag{12}$$

where T is the design life and R(t) is the satellite reliability. Note that MMD is always less than the design life, asymptotically approaching T as redundancy is increased. On the other hand, MTTF = MMD(∞) and is not similarly constrained. In terms of MMD, increases in redundancy without a design life improvement could be wasteful. Again, an increase in mission cost would result, since satellite cost increases would not be accompanied by a marked decrease in launch frequency and cost. For this study, simulation results with MTTF above 3 or 4 years are probably not representative, unless all elements (e.g., solar array, batteries) have design lives on the order of 5 to 10 years.*

6.1.2 Effect of Satellite Maintenance

Satellite maintenance using Shuttle retrieval or resupply offers conclusive advantages over the expendable alternatives (Figure 6-1). Availability is improved because some service flights are made in order to prevent loss of the satellite (an abort capability), prior to loss of operational status.

Mission costs are decreased by reuse of satellite hardware as can be seen from Table 6-2, which shows the total launch costs for each approach to system maintenance. Launch costs are higher with Shuttle resupply or retrieval than in the expendable Shuttle application mode, due partly to the somewhat larger number of flights but mainly due to the absence of high-altitude expendable launches (which, according to the selected cost algorithm are almost 4 times more expensive than low altitude flights). These increased launch costs are more than offset by savings in satellite equipment, as evidenced by the total mission costs.

6.1.3 Effect of Conventional Launch Vehicle

For an expendable system maintenance philosophy, Shuttle launch to low altitude (with subsequent orbit transfer using spacecraft propulsion) is more cost effective than direct injection using a Thor-Delta 2910 launch vehicle. This lower cost-per-launch is a direct function of the Shuttle costing algorithm, which assumes that the payload capability not used by EOS can be used by other missions. If EOS had to pay the total cost of dedicated Shuttle launches, this conclusion would no longer be true. Here, as in other areas, the conclusions are determined largely by the Shuttle costing model.

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*At high levels of redundancy flights are becoming so infrequent that additional flights may have to be scheduled to update payloads. If these factors are included, highest redundancy may not yield the most cost effective approach.

Table 6-2. Summary of Launch Cost Data for 10 Year Mission

Launch Delay (months)	Satellite Design	Total Launch Costs ($M)					
		Expendable		Resupply		Retrieval	
		Conventional Launch Vehicle	Shuttle Launch	Baseline Service	Alternate Service	Baseline Service	Alternate Service
3	MIN-A	59.6	15.6	43.5	43.5	62.4	62.4
3	VAR1-A	32.7	8.7	26.9	25.1	33.5	33.4
3	VAR2-A	25.6	6.9	20.7	20.5	24.3	26.5
3	NOM-A	18.8	5.1	14.6	10.6	15.4	11.7
3	NOM-B	15.8	4.4	14.3	9.9	15.4	11.2
3	GRO-B	14.0	4.0	6.3	8.1	6.3	8.3
1	MIN-A	74.2	19.5	50.2	50.2	72.4	72.4
1	VAR1-A	36.3	9.7	28.9	28.0	36.5	37.3
1	VAR2-A	28.2	7.6	23.5	19.6	27.9	25.5
1	NOM-A	19.2	5.2	15.1	11.4	16.0	12.4
1	NOM-B	16.8	4.7	15.2	10.6	16.4	11.8
1	GRO-B	13.6	3.9	7.0	7.8	7.1	8.2

6.1.4 Effect of Retrieval vs. Resupply

The simulation data shows a consistent advantage for resupply (on-orbit module replacement) when compared with retrieval (ground refurbishment). These differences occur in the launch costs (lower because the average payload weight is lower) and in the equipment rework costs (which for retrieval include detecting and correcting problems introduced in all modules due to the Shuttle return flight environment). The launch cost differences are particularly sensitive to the FSS and SPMS weights, and emphasize the desirability of lightweight implementation of these mechanisms. As before, the Shuttle costing model plays a key role in determining mission costs.

6.1.5 Effect of Servicing Policy

For both resupply and retrieval two servicing policies were evaluated. The baseline scheme anticipates loss of deboost capability by servicing when a failure causes any Class 2 group to become one failure away from loss. The alternate logic, like the baseline, services on:

- loss of any Class 1 group,
- loss of any Class 2 group,
- one-away from loss of any Class 3 group,

but does not anticipate loss of deboost capability.

The results show the alternate policy more cost effective in all cases except those with the GRO-B satellite design. In most cases the baseline logic results in considerably more Shuttle flights, without a compensating decrease in the number of high altitude flights. With the GRO-B design, in which a number of Class 2 and Class 3 groups are made triple-redundant, the number of Shuttle flights with the baseline logic is less than half its value with any other design; there are in this case few opportunities for a Class 2 group to be one failure away from loss.

Although generally more cost effective, the alternate logic does lead to more system down time (Figure 6-2), because a higher percentage of flights occur after the satellite has gone down. There is, therefore, a cost-availability tradeoff to be considered.

6.1.6 Effect of Launch Delay

Decreasing the elapsed time between a flight decision and occurrence of the flight has the expected effect of increasing availability and cost. However, the actual cost increase is probably much greater than the increment shown, because the schedule-related cost increases in reducing turnaround from 3 months to 1 month are not included.

6.2 RECOMMENDATIONS FOR FUTURE STUDIES

The results of this study have led to some interesting conclusions as discussed in the preceding section. Some of these conclusions are simulation model and data dependent as noted above. Further mission tradeoff studies, exploring those issues and others, are suggested, including the following:

- Shuttle Cost Model. The above conclusions appear to depend strongly upon the model used to charge the EOS program for use of the Shuttle. With this in mind, the model should be reviewed and perhaps revised. Future studies could include any new Shuttle cost model suggested by GSFC.

- Design Life Simulation. Realistic inclusion of time-related component degradation is desirable, particularly if highly redundant designs are to be considered. The model of degradation must consider several levels of performance, analogous to the component group classes now used, because exceeding the design life of an array (for example) will not prevent deboost or cause loss of the satellite.

- Redundancy Studies. Studies thus far suggest that increases of above the GRO-B configuration may penalize mission cost. Definition and study of such designs is suggested, but must be accompanied by a realistic design life model and instrument upgrading policies.

- Payload Cost Data. As noted earlier, sufficiently detailed payload cost data was unavailable for this study. Development and inclusion of more definitive data is suggested. In this context alternate payload sensors (TM, HRPI) can be modeled and evaluated.

- Alternate Missions. This study has considered a single-satellite/single-instrument system. Future studies should deal with realistic alternatives (e.g., multiple satellite or a single-satellite with tandem sensors), considering an availability model which accounts for degraded operation (e.g., one of two sensors operating).

- Inventory Effects. The selected mission simulation model has assumed a fixed delay between launch decision and flight. In fact, the delay will depend on a variety of factors, including module inventory. Advanced studies can evaluate the effect of module inventory limitations on total mission costs.

7. REFERENCES

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3. TRW Report 22296-6001-RU-000, " EOS System Definition Study Report No. 1: Orbit/Launch Vehicle Tradeoff Studies and Recommendations," Preliminary Draft, 15 July 1974.

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APPENDIX A

SIMULATION MODEL AND COMPUTER PROGRAM

APPENDIX A

SIMULATION MODEL AND COMPUTER PROGRAM

1. INTRODUCTION

The economic assessment of the launch, retrieval, and resupply modes of servicing the EOS with the Space Transportation System (STS) is made using results derived from a computer simulation model of satellite deployment, in-space refurbishment and servicing, and retrieval and ground refurbishment.

The basis for the computer simulation is the satellite mission life cycle cost simulation model. This general simulation model and its implementation using a computer have been under development by TRW for approximately two years. The model is generally sufficient to handle the economic analysis of the EOS satellite; however, this study did necessitate the inclusion of EOS-specific cost and space servicing details.

The satellite mission life cycle cost simulation model, Figure A-1, shows the essential operations or activities encountered in deploying and maintaining a satellite or constellation of satellites in orbit for the life of the mission. The activities encompass all those operations required for on-the-ground support, Space Shuttle launch, in-space operation, service launch decisions, in-space servicing, and retrieval and ground refurbishment. Monte Carlo techniques are used with statistical representations of each important parameter.

An "activity" is a function (designated by a box in Figure A-1) which receives an input, performs a transformation on that input, and produces an output. For example, a packet of information in the form of an order enters satellite equipment manufacturing (Activity 44, Figure A-1) and at some time later an output, which is a grouping of space replaceable unit(s) (SRU's), leaves the activity. The activities shown in the model are all interconnected with arrows that represent the inputs and outputs. A solid arrow represents the flow of hardware (i.e., Space Shuttle, satellite, group of SRU's, or one SRU) and a dotted arrow represents the flow of information (e.g., flight order, failure order, or hardware order).

As the hardware and orders flow through the activities, the time is advanced according to the time (in hours) assigned to perform an activity. For example, suppose a payload installation into a Shuttle at A-19, takes 169.6 hours; therefore, if the Shuttle was available when a satellite entered at 8765.4 hours, the Shuttle would move into A-24 at 8935.0 hours. The time required to perform an activity is chosen by drawing a random number, entering the distribution describing the time variation and picking the actual time for that specific operation. The movements of the hardware and orders take place as they complete activities; i.e., between 8765.4 hours and 8935.0 hours there may be a component failure order leave A-65 at 8766.2 hours, a spacecraft may leave A-44 at 8830.9 hours and a Shuttle leave A-27 at 8921.6 hours.

In addition to time advancement, program cost accumulation occurs as hardware and orders flow through cost-related activities (e.g., satellite equipment manufacturing, SRU rework, etc.). Costs are computed based upon the relevant general formulas and particular input values.

The activities represented in the model of Figure A-1 are considered a reasonable and practical representation of all the pertinent interfaces and decision criteria for the EOS study. A few minor improvements could not be included within the schedule and budget constraints of the study. However, the detail logic content of each activity is so constructed that the incorporation of foreseeable future model improvements would not require complete revision of the activity.

1.1 Simulation Model

In order to point out the primary features incorporated in the activities of the satellite mission life cycle cost simulation model, a detailed explanation of typical movements of hardware and orders is presented below. The model, Figure A-1, should be referred to at each transfer. In the explanation, A-number means an activity identified by that number, as shown in the square in the upper left corner of each activity block. The circled number in the upper right corner of each block is used by the computer for the selection of the proper logic.

At time 0, several actions are initiated in the model. First orders leave A-79, general order insertion, and enter A-1, Satellite flight

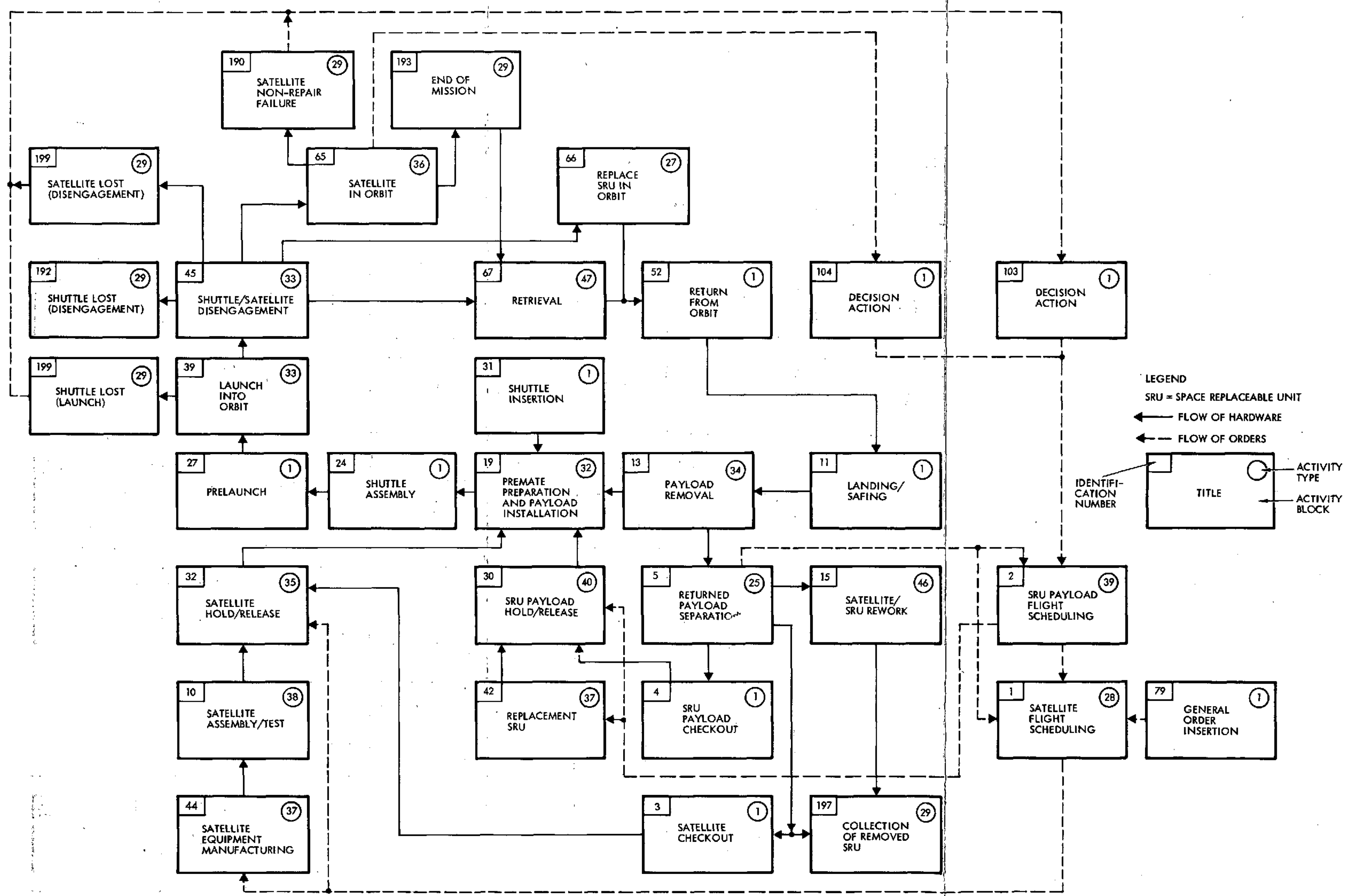

Figure A-1. Satellite Mission Simulation Model

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scheduling. Then Space Shuttle leaves A-31, shuttle insertion, and position themselves in A-19, premate preparation. Flight orders and launch orders which establish the number of satellites to be put in orbit and launched on a given flight, move from A-1, satellite flight scheduling, to A-32, satellite hold/release, and manufacturing orders, which initiate manufacture of the appropriate number of satellites, move from A-1 to A-44.

To simulate the satellite assembly and test process, the orders in A-44 begin a cycle to make available satellites according to a prescribed time schedule. A satellite section is defined as the SRU and nonreplaceable units (NRU) which comprise a complete satellite. Here the production cost of a satellite is computed based upon component costs, SRU-level costs, and multiplicative factors for buying and manufacturing. As the sections are available, they move into A-10, satellite assembly/test. In A-10 it is assumed that only one satellite can be assembled and tested at one time. The satellite moves into A-32, satellite hold/release, when it is finished in A-10.

The completed satellite joins with the flight order in A-32. When the appropriate number of satellites to be flown on a given launch (one for the EOS system) are available, the satellite(s)/flight order(s) join with the launch order, and are released into A-19, premate preparation and payload installation. A-32 will hold satellites and release them only when launch and flight orders are available, or will hold orders and release them only when a satellite enters. For example, if five satellites are assembled and are available at three month intervals, and four flight orders are ready at 0 time, then each of the first four satellites will move through A-32 into A-19 as it completes A-10. The fifth satellite will remain in A-32 until a satellite in orbit needs to be replaced; detection of a nonrepairable satellite initiates replacement flight and launch orders which joins up with the fifth satellite in A-32. Now, if a second satellite needs to be replaced, the flight and launch orders for its replacement would wait in A-32 until an additional satellite can be produced.

In A-19, premate preparation and payload installation, the satellite is joined to the Shuttle. In this activity, it is assumed that only one payload installation can take place at one time. The now-loaded Shuttle advances through A-24, Shuttle assembly, and A-27, prelaunch. Here

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the costs associated with launching the satellite are accumulated. For the EOS, table of weight and cost values is input in order to make this calculation. For all cases (launch only, resupply, retrieval), cost is a function of weight carried up. The loaded Shuttle moves into A-39, launch into orbit, where it is subject to a possible random loss which is specified as a probability. The actual loss determination is made by a random number draw which is compared to the specified probability. If the Shuttle survives A-39, it moves into A-45, Shuttle/satellite disengagement. Here, too, the satellite is subject to possible random loss, as in A-39. At this point, the satellite is separated from the Shuttle upper stage (OOS) and they are modelled separately. The Shuttle moves through A-52, return from orbit, A-11, landing/safing, and A-13, payload removal. Finally, the Shuttle is refurbished (not included in this model) and returns to A-19 to await another payload.

The satellite leaves A-45, moves into A-65, satellite in orbit, and is put into active service. A satellite is comprised of a number of SRU's and NRU's, each of which is described by a reliability block diagram of series and/or redundant components (such as receivers, transmitters, batteries, earth sensors, etc.). These are turned on by selecting a random number and using the component's reliability description, failure rate (λ), and a shape parameter (β) to calculate a time to failure. All SRU's and NRU's component failure times are reviewed after these calculations and the failure time which is closest to present time is entered as the next event.

Each component is given a severity classification based upon the effect its failure would have on the satellite. As failures occur, redundant groups of components move into different failure "states," depending upon the component class. Servicing decisions are made based upon these satellite states.

The mission starts when a prescribed number of satellites comprising a constellation are all in orbit and operational. For example, if by the time the last satellite of the constellation is activated an earlier launched satellite has become inoperative, the mission has not started. The entire constellation must be operational simultaneously to commence the mission. Although all satellites are alike from the standpoint of hardware (SRU/NRU) configuration, it is possible in the model to specify an operational difference for an individual satellite. In an extreme case, one satellite may have an SRU with all components turned on while another may have the same SRU with all components turned off.

Whenever the component failure time (i.e., next event) of a satellite in orbit arrives, the satellite is completely reevaluated to determine its operational status. There are two types of situations, an SRU component failure or an NRU failure, each of which will be explained below.

Every SRU component failure causes a failure order to be generated so that the details of this failure can be evaluated on the ground. The SRU which contains the defective component is evaluated for sufficient component redundancy. A standby component is turned on, if available. If this component failure causes the SRU to be inoperative, this is noted by a decrease in the number of operating satellites, i.e., change in satellite availability. All SRU's of the satellite are now searched in order to find the next expected component failure time (i.e., next event). A failure order leaves A-65 and moves into A-104, decision action. This activity, A-104, is inserted to allow a time delay for ground evaluation of the data (for this study the delay time is set to 0). The failure order moves into A-2, SRU payload flight scheduling, where the pertinent failure data is entered in a summary table. After each failure entry, all table entries are reviewed in order to determine whether a service flight is required. A space servicing flight is initiated in the EOS resupply case when the satellite is in one of the following states: 1) the failure of a component or SRU causes a satellite to be inoperative or, 2) one additional failure of a component in a redundant group would cause loss of the satellite, or, 3) either failure or one additional failure (depending upon which input option is chosen) of a component would prevent satellite boost/deboosting. If one of the aforementioned criteria is met, then a service flight order moves out of A-2 into A-42, replacement SRU, where the required payload SRU's are generated. After the SRU payload information is left in A-42, the order moves into A-30, SRU payload hold/release, to await replacement. When the proper SRU's for that service flight are accumulated in A-30, the SRU group combines with the failure order and the payload moves into A-19 to load into the Service OOS to go up on an available

Shuttle. The Shuttle/service OOS moves with its load as previously described for a satellite launch, except that it moves through A-45 without a time change and the load does not separate from the service OOS. The service OOS and SRU payload go into A-66, replace SRU in-orbit. The service OOS visits each satellite needing repair and all the new SRU's are put into the satellites and the old ones are brought aboard the Shuttle. When an exchange of SRU's is complete for a satellite, the new ones are activated, as previously described for a newly launched satellite, and the next new component failure time is determined. If the satellite was inoperative, it is now made operative. This is noted by an increase in the number of satellites operable.

Servicing flights for the EOS are made to either low altitude or high altitude depending upon the classification of a component group and how many units are failed. High-altitude servicing is performed in the event of failure of a Class 2 component group; otherwise, low-altitude servicing is performed.

The Shuttle with the old SRU's moves through A-52, A-11 and into A-13. However this time, since there is a returned payload, it is separated from the Shuttle. The Shuttle goes into A-19 to await another payload, and the returned payload moves into A-5, returned payload separation, where the failure order is separated from the old SRU's. The payload then moves to A-15, where costs of reworking the returned SRU's are accrued based upon their failed components. The returned payload then moves into A-197, collection of returned payloads, where a fixed SRU rework cost is accrued. The failure order goes into A-2, SRU payload flight scheduling, where it removes all entries pertaining to its replacement flight since the task is completed. The entries are left in the summary table so that in case an SRU replacement payload is lost it can be repeated.

An NRU failure in a satellite causes it to be inoperative; the satellite cannot be repaired by replacing a unit, therefore, a new satellite must be launched. A satellite which becomes inoperative due to an NRU failure moves out of A-65 into A-190, satellite nonrepair failure, and the number of operating satellites is decreased. The satellite remains in A-190; however, its flight order, which had previously joined with the satellite in A-32, is now released. The flight order moves into A-103, decision action, the time delay for a ground decision (in this model it is set to 0). Next, the flight order goes into A-2, it examines the component failure summary table and removes all SRU entries which are related to the nonrepairable failed satellite. After this, the flight order moves into A-1, satellite flight scheduling, if there is a completed satellite ready (e.g., if only four were required for starting a mission but five were manufactured in the production run), then the flight order will go directly to A-32 and proceed as previously described.

If there is not a completed satellite ready, the flight order generates a hardware order which will start the production of a new satellite, as well as a launch order. The launch order moves to A-32. The hardware order moves into A-44 and starts the production cycle for the satellite sections. In this latter case, the flight order moves in A-32 to await the new satellite and proceed as previously described. Whenever the need for a new satellite comes so late in a mission that its orbital operating time would be too short, flight hardware order does not proceed any further than A-1.

If the retrieval option is chosen, a retrieval order is generated in A-1, and sent to A-32, where it mates with the appropriate launch order to retrieve the appropriate (failed) satellite. In A-45 the retrieval order, along with the Shuttle, separates from the newly launched satellite. Both Shuttle and retrieval order move into A-67, retrieval, where both mate with the failed satellite. The Shuttle and retrieval satellite are separated in A-5, and the satellite moves into A-15, satellite rework, where all its failed components are reworked. Costs are accumulated here based upon components reworked. The reworked satellite then moves into A-197, and eventually to A-32, where it waits for launch and flight orders.

In the case where a satellite is lost, as in A-199, satellite lost, the flight order is removed from the satellite and the order proceeds in the same manner as described for a satellite nonrepairable failure. Eventually the time advances to the end of the mission, at which time all operating satellites moved from A-65, satellite in-orbit, to A-193, end of mission.

2. COMPUTER PROGRAM

The simulation model computer program is a discrete event program, one in which items are processed through an activity with definite start and finish times. Time starts at 0 and increases from event to event until the mission is completed. The events are variable time incremented which means that the time of the next event is as it occurs, i. e., a series of events may occur at 10, 531. 6, 10, 631. 7, 10, 632. 8, 10, 633. 4, and 12, 222. 2 hours. As previously mentioned, both hardware and orders have substance; they are entities that move their activities.

No attempt will be made here to explain or show the computer program in its entirety. It is a 7000-card program composed of a main program and 51 subroutines. However, a simplified logic flow chart of the main program will give the essence of the program.

Figure A-2 shows a very simplified logic flow diagram of the main program. This flow chart depicts the movements of the computer through the instructions which manipulate the model. This is essentially a driver that calls subroutines as it moves from the start through the actions and decisions enough times in order to manipulate the model's hardware and orders until it reaches the end.

In summary, as each event is encountered a piece of hardware or order is moved from the activity it just finished into the next activity and it is rescheduled; the cycle is repeated until there is nothing else to move.

The following discussion covers each of the 10 numbered rectangles, parallelogram and diamonds of the logic flow chart, Figure A-3.

1) Input data and initial conditions. The input data to the program consists of activity descriptions, hardware/order descriptions, SRU/NRU unit descriptions, and timeline analysis. As the input data cards are read into the computer, some error checking is performed on the most expected keypunch and user data inconsistency errors. If an error or a contradiction in data is found, then a diagnostic message is printed. A set of activity description data cards contain information relating to connecting to its input and output activities, activity type and identification numbers, a list of descriptors, and the initial (0 time) status. The hardware/order descriptions establish the condition of all necessary initial (0 time) locations, scheduled event time, information relating to hook-up with other hardware or orders, and any queueing states. The SRU/NRU unit descriptions give the composition of the

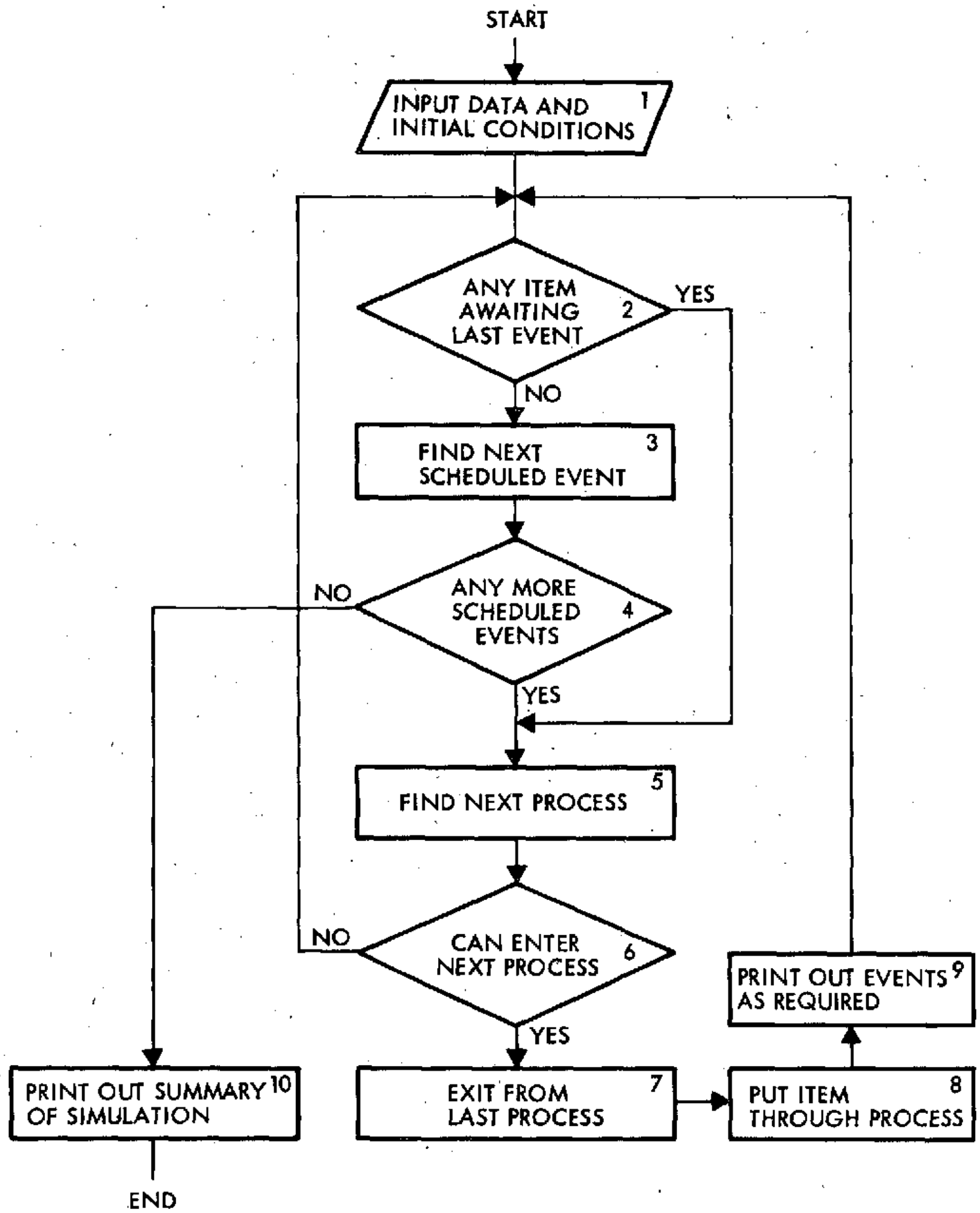

Figure A-2. Program Logic Flow

unit in terms of all its components, i. e., reliability block diagram, component reliability descriptors, and component cost.

As an aid to interpretation and review of the input data, a printout is made in a narrative form which shows what has been read into the computer. The inputted data does not contain narrative, it just contains numbers which described the data set. The input data format is shown in Figure A-3.

Process Description

```
PROCESS  52    *** RETURN FROM ORBIT                        ***
   IT IS LOCATED AT POSITION  263 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
         1.00,       8.00,       0.00,       0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 2 INPUT PROCESSES ARE   39,   45,
  THE  1 OUTPUT PROCESSES ARE   11,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
```

.... (All processes described)
....

```
                 ***** SHUTTLE/SATELLITE/UNIT    DISPOSITION AT START *****

THE      ORDER 80001 IS SCHEDULED TO LEAVE PROCESS  79 AT      0.000 HOURS.

THE SHUTTLE  *0001 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0002 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0003 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0004 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD
```

.... (All zero time conditions specified)
....

***** SRU/NRU UNIT DESCRIPTION *****

SRU ------------SOLAR ARRAY-DRIVE MODULE

MODEL 1 SRU EQUIV. 1 WEIGHT 233 NO. OF COMP. 11

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10601.03	*00000000.	1.0000	ACTIVE 1.00	*00000.	AD STR	92000.00 MFG.
10603.01	100000000	1.0000	ACTIVE 1.00	*00000.	THER	12000.00 MFG.
10651.03	4000000	1.0000	ACTIVE 1.00	*00000.	A DRIV	45000.00 MFG.
10651.03	4000000	1.0000	STNDBY .10	*00000.	A DRIV	45000.00 MFG.
10652.03	220410	1.0000	ACTIVE 1.00	*00000.	AD ELE	30000.00 MFG.
10652.03	220410	1.0000	STNDBY .10	*00000.	AD ELE	30000.00 MFG.
10631.02	288684	1.0000	ACTIVE 1.00	*00000.	DI/SCU	22000.00 MFG.
10611.03	1176471	1.0000	ACTIVE 1.00	*00000.	AD PCU	25000.00 MFG.
10611.03	1176471	1.0000	STNDBY .10	*00000.	AD PCU	25000.00 MFG.
10653.03	*00000000.	1.0000	ACTIVE 1.00	*00000.	ARRAY	528000.00 MFG.
10691.03	*00000000.	1.0000	ACTIVE 1.00	*00000.	HARN	10000.00 MFG.

BUILD COST .0250 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

(All SRU's and/or NRU's listed)

Figure A-3. Standard Input Data Format — Satellite Mission Life Cycle Cost Simulation Model Computer Program

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Since the expected inputs can be extensive, attempts are made to keep the amount of computer memory used to a minimum. The various activity types are of different lengths in terms of computer words; therefore, it is most economical to store this in a packed fashion. For this reason, the location of a specific data must be accessed by formula within an activity. In order to get the quickest transfer from one activity to another, the input and output activity identification numbers are converted to relative computer locations and stored with the other activity descriptors. As an assist for the user, it is not necessary to numerically order the activity identification number within the input data card deck. During this input phase all the starting values are initialized.

2) Any item awaiting last event? As the program starts manipulating the model, instances will occur in which the hardware/order must wait for a future event whose time may not be predictable in advance. Therefore, the item must wait and any last event must be checked against waiting items to see if the event was the one which was being waited on. For example, the only Shuttle in A-19 (see Figure A-1) may be having a satellite put onboard and an SRU payload may be ready to go onboard a Shuttle. The SRU payload must wait until another Shuttle arrives or this Shuttle makes its round trip (if it happens to be the only one). The check for this type of situation is made here. Whenever the last event occurrence does not release a waiting item, the program goes for the next event. A released waiting item becomes the next event, thus by-passing 3) and 4).

3) Find next scheduled event. The time of the next event and the activity location at which it is located is found.

4) Any more scheduled events? When there are no more scheduled events the mission simulation will proceed to a finish, otherwise it continues.

5) Find next process. The location of the next activity is found. This can be a single choice, such as the Shuttle going from A-19 to A-24. It can also be one of several paths, such as an order leaving A-2, in which case the correct path depends upon the characteristic (type of contained information) of the order. Another situation could be the move from A-39 where the Shuttle can go to A-45 to A-199, depending on the value of a random number.

6) Can enter next process? There are instances when the next activity cannot accept the item waiting to enter. This situation is discovered by interrogating the internal state of the next activity. In the Shuttle/payload example described in 2), the SRU payload gets into the await status through this processing. The SRU payload found only one Shuttle and that was being loaded, therefore, it went into an await so as to

let the next event come up. Eventually some future next event would be the one for which the SRU payload was waiting. If entry is unobstructed, the item moves on.

7) Exit from last process. Prior to the item leaving the current activity for the next activity, the status of the current activity must be reset to account for the leaving of the item. Thus, another item at a future next event will see the correct status of the activity when it interrogates as described in 6).

8) Put item through process. The next activity now becomes the current activity, the entering item is set into the activity and the proper transformation is made with a scheduled completion time.

9) Printout events as required. As events take place, any record of the details which have transpired are printed out or saved for future summarization. This completes the main loop of instructions.

10) Printout summary of simulation. When the simulation is completed, the results which best describe the happenings are printed. A concise selection of the most descriptive data is outputted, because data from the total number of events are great in volume and unwieldy to interpret. (See Figure A-4.)

The simplified logic flow chart depicts a single simulation of a mission. The simulation is a (dynamic) Monte Carlo type; therefore, to observe the variations in the measured parameters of the mission system many simulations are made. The logic flow chart would be modified for many simulations by looping up to initial conditions instead of printing out a summary. This printout would be made after a significant number of simulations. In this case, the essential events (see 9)) for only one mission are printed out, since a printout for many missions would be huge (several hundred pages).

***** AVAILABILITY *****

THERE WERE 100 MISSIONS WHICH ACCUMULATED .8760000 OPERATING HOURS IN ORBIT.

THERE ARE 0 SATELLITES OPERATING FOR 13.871 PERCENT OF THE TIME.
MINIMUM 2.50 PERCENT
AVERAGE 13.87 PERCENT
MAXIMUM 26.07 PERCENT
STANDARD DEVIATION 4.70 PERCENT

THERE ARE 1 SATELLITES OPERATING FOR 86.129 PERCENT OF THE TIME.
MINIMUM 73.93 PERCENT
AVERAGE 86.13 PERCENT
MAXIMUM 97.50 PERCENT
STANDARD DEVIATION 4.70 PERCENT

*** FREQUENCY DISTRIBUTION OF SHUTTLE LAUNCHES REQUIRED ***

LAUNCHES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
OCCURNC	0	1	0	4	8	17	14	13	18	17	4	3	0	1	0
NORM	0.00	.06	0.00	.22	.44	.54	.78	.72	1.00	.94	.22	.17	0.00	.06	0.00
CUM	C.00	.01	.01	.05	.13	.30	.44	.57	.75	.92	.56	.99	.99	1.0C	1.00
LAUNCHES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

MINIMUM = 2.00

AVERAGE = 7.88

MAXIMUM = 14.00

MEDIAN = 8.00

MODE = 5.00

STANDARD DEVIATION = 2.14

*** SHUTTLE LAUNCH TIME DISTRIBUTION ***

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED IN EACH TIME INTERVAL.

THE TOTAL TIME SPANNED IS 131400.0 HOURS.

EACH INTERVAL IS 2190.0 HOURS.

AVG. NO.	1.00	.10	.18	.21	.17	.24	.15	.15	.18	.28	.14	.13	.19	.15	.20	.14	.28	.25	.14	.21
INTERVAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

AVG. NO.	.14	.17	.19	.17	.12	.11	.12	.11	.18	.17	.2C	.14	.15	.15	.17	.19	.23	.19	.21	.23
INTERVAL	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

AVG. NO.	.05	0.0C	0.00	0.00	0.00	0.C0	0.00	0.00	0.00	0.00	0.0C	0.00	0.00	0.0C	C.00	0.00	0.00	0.00	C.0C	0.00
INTERVAL	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

THE MIN. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 2.00

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 7.88

THE MAX. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 14.00

LOW ALTITUDE LAUNCHES PER MISSION

MINIMUM = 1.00
AVERAGE = 3.58
MAXIMUM = 8.00
STD DEV = 1.67

HIGH ALTITUDE LAUNCHES PER MISSION

MINIMUM = 0.00
AVERAGE = 3.90
MAXIMUM = 9.00
STD DEV = 1.77

Figure A-4. Standard Output Data Format — Satellite Mission Life Cycle Cost Simulation Model Computer Program

```
***** SERVICE FLIGHT INITIATICN STATISTICS *****

THERE IS AN AVERAGE OF   6.85 SERVICE FLIGHTS PER MISSICN

100.00 PERCENT WERE DUE TO AN SRU REACHING A MANDATCRY STATE
         0.00 PERCENT WERE IN STATE   5
         0.00 PERCENT WERE IN STATE   6
        25.11 PERCENT WERE IN STATE   7
        17.96 PERCENT WERE IN STATE   8
        56.93 PERCENT WERE IN STATE   9
```

```
*** SRU REPLACEMENT PER SERVICE FLIGHT DISTRIBUTION ***

BOX EQUI    1    2    3    4    5    6

OCCURNC    39  382  197   59    8    C
   NCRM   .10 1.00  .52  .15  .C2 0.C0
    CUM   .C6  .61  .90  .99 1.00 1.C0

BCX EQUI    1    2    3    4    5    6

                                        MINIMUM =      1.00
                                        AVERAGE =      2.44
                                        MAXIMUM =      5.00
                                         MEDIAN =      2.00
                                           MODE =      2.00
                             STANDARD DEVIATION =       .78
```

```
*** SRU MCDELS REWORKEC ***

SRU MOD     0    1    2    3    4    5    6    7    8    9   10   11   12   13   14

OCCURNC     0   79   89  22E  373  6E5    0    0    0    0    C  170    0   56    0
  RATIO  0.00  .05  .05  .13  .22  .41 C.00 0.00 0.00 0.0C 0.0C  .10 0.00  .03 C.00

SRU MOD     0    1    2    3    4    5    6    7    8    9   10   11   12   13   14
```

```
***** SATELLITE SERVICE VISITS *****

WEIGHT FOR  1 SATELLITES

   MINIMUM =  232.90
   AVERAGE = 1514.25
   MAXIMUM = 2358.90
   STD DEV =  229.43
```

```
*** REPLACEMENT SATELLITES MISSION FRECUENCY DISTRIBUTION ***

SATELLIT    0    1    2

OCCURNC    97    3    0
   NORM  1.00  .03 0.00
    CUM   .97 1.0C 1.00

SATELLIT    0    1    2

                                        MINIMUM =      0.00
                                        AVERAGE =       .03
                                        MAXIMUM =      1.00
                                         MEDIAN =      0.00
                                           MODE =      0.00
                             STANDARD DEVIATION =       .[illegible]
```

Figure A-4. Standard Output Data Format — Satellite Mission Life Cycle Cost Simulation Model Computer Program (Continued)

*** MISSION COST (MILLIONS) ***

COST DLR	20	30	40	50	60	70	80	90	100	110	120
OCCURNC	0	3	15	15	34	17	12	1	2	1	C
NORM	0.00	.09	.44	.44	1.00	.50	.35	.03	.06	.03	0.00
CUM	C.00	.03	.18	.33	.67	.84	.96	.97	.99	1.00	1.0C
COST DLR	20	30	40	50	60	70	80	90	100	110	120

***** ACTIVITY COST SUMMARY *****

ID	NAME/DESCRIPTION	START HRS *	FINISH HRS *	COST (MILLIONS OF DOLLARS) MIN	AVG	MAX	STD DEV
15	SRU REWORK	-1.0	-1.0	.591	2.183	9.753	1.102
27	LAUNCH	-1.0	-1.0	10.267	40.873	86.146	14.417
44	SPACECRAFT EQUIP. MFG	-1.0	-1.0	11.614	11.563	23.228	1.981
	**** ACTIVITY TOTALS ****			22.688	55.019	100.634	15.181

* TYPICAL TIME FOR 1ST ITEM ENTRY AND LAST ITEM COMPLETION FOR MISSION SIMULATION 100

SRU MODEL NUMBER 4 - ATTITUDE DETERM. MODULE

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 4.76
MAXIMUM = 9.00
STD DEV = 1.36

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4	5	6	7	8	9
OCCURNC	1	4	10	30	28	20	3	3	1	0
NORM	.03	.13	.33	1.00	.93	.67	.10	.10	.03	0.00
CUM	.01	.05	.15	.45	.73	.93	.96	.99	1.00	1.00
NO. REQ	0	1	2	3	4	5	6	7	8	9

MINIMUM = 0.00
AVERAGE = 3.73
MAXIMUM = 8.00
MEDIAN = 4.00
MODE = 3.00
STANDARD DEVIATION = 1.38

Figure A-4. Standard Output Data Format — Satellite Mission Life Cycle Cost Simulation Model Computer Program (Continued)

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APPENDIX B

REPRESENTATIVE MISSION SIMULATION FOR LAUNCH-ONLY SHUTTLE MODE

```
*********************************
*SATELLITE LIFE CYCLE COST MCDEL*
*********************************

DATE:   09/12/74.

RUN DESCRIPTION:EOS - LAUNCH ONLY,NOMINAL,PAYLOAD A,1 MO. DELAY

NUMBER OF SIMULATIONS:        1CC

FAILURE RATE K FACTCR:     1.0CO
(INCLUDED IN PRINTED MTBF VALUES)
```

```
***** PROCESS DESCRIPTION          *****

PROCESS   1    *** SATELLITE FLIGHT SCHEDULING      ***
  IT IS LOCATED AT POSITION  167 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 28 HAS 21 DESCRIPTORS.
        1.00,      1.00,      0.00,    730.00,      1.00,      1.00,      0.00,     14.00,      0.00,
        0.00, *99999.00, *99999.00,      0.00,      0.00,      0.00,      0.00,      0.00,      1.00,
        1.00,      0.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE    5,    2,   79,
 THE  3 OUTPUT PROCESSES ARE   32,   -1,   44,
   OUTPUT SCHEME 15 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS   2    *** SRU REPLACEMENT SCHEDULING       ***
  IT IS LOCATED AT POSITION   72 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 39 HAS 11 DESCRIPTORS.
       98.00,      0.00,      0.00, *99999.00,      4.00, *99999.00, *99999.00, *99999.00, *99999.00,
        4.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE  104,  103,   42,
 THE  3 OUTPUT PROCESSES ARE   42,   30,    1,
   OUTPUT SCHEME 13 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS   3    *** SATELLITE CHECKOUT               ***
  IT IS LOCATED AT POSITION  366 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
        1.00,     72.00,      0.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE    5,
 THE  1 OUTPUT PROCESSES ARE   32,
   OUTPUT SCHEME  0 IS USED
 10 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
```

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```
   INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN

 PROCESS   4    *** SRU RETURN CHECKOUT                    ***
    IT IS LOCATED AT POSITION   13 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
          1.00,     72.00,      0.00,      0.00,
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE     5,
   THE  1 OUTPUT PROCESSES ARE   30,
     OUTPUT SCHEME  0 IS USED
    1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN

 PROCESS   5    *** PAYLOAD RETURN SEPARATION              ***
    IT IS LOCATED AT POSITION   28 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 25 HAS  1 DESCRIPTORS.
          0.00,
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE    13,
   THE  8 OUTPUT PROCESSES ARE    1,    3,   30,    4,    2,   15,   -1,  198,
     OUTPUT SCHEME 16 IS USED
   *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN

 PROCESS  10    *** SATELLITE ASSEMBLY/TEST                ***
    IT IS LOCATED AT POSITION  491 OF THE INTERNAL COMPUTER LIST AREA.
   PROCESS TRANSFORMATION TYPE 38 HAS 10 DESCRIPTORS.
          1.00,      .00,      0.00,      1.00,      5.00,      0.00,      0.00,      0.00,      0.00,
          0.00,
     REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   THE 1 INPUT PROCESSES ARE    44,
   THE  1 OUTPUT PROCESSES ARE   32,
     OUTPUT SCHEME  0 IS USED
   *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
   INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
   THE INITIAL PROCESS STATUS IS OPEN
```

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PROCESS  11    *** LANDING/SAFING                                    ***
  IT IS LOCATED AT POSITION  351 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
        1.00,       9.60,       0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   52,
 THE  1 OUTPUT PROCESSES ARE   13,
   OUTPUT SCHEME  0 IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN


PROCESS  13    *** PAYLOAD REMOVAL/SHUTTLE MAINTEN. ***
  IT IS LOCATED AT POSITION  332 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 34 HAS  7 DESCRIPTORS.
        1.00,      60.80,       0.00,       1.00,      10.00,       0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   11,
 THE  2 OUTPUT PROCESSES ARE   19,    5,
   OUTPUT SCHEME 11 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN


PROCESS  15    *** SRU REWORK                                        ***
  IT IS LOCATED AT POSITION  547 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 46 HAS  4 DESCRIPTORS.
        1.00, *99999.00,       0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE    5,
 THE  1 OUTPUT PROCESSES ARE   -1,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS SPECIAL


PROCESS  19    *** PREMATE PREP/PAYLOAD INSTALL                      ***
```

```
  IT IS LOCATED AT POSITION  203 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 32 HAS  8 DESCRIPTORS.
       1.00,    730.00,     0.00,     0.00,     0.00,     0.00,     0.00,     0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE   13,   32,   31,
 THE  1 OUTPUT PROCESSES ARE   24,
   OUTPUT SCHEME  0 IS USED
  5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS SPECIAL


PROCESS  24    *** SHUTTLE ASSEMBLY                      ***
  IT IS LOCATED AT POSITION  381 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       1.00,     0.00,     0.00,     0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   19,
 THE  1 OUTPUT PROCESSES ARE   27,
   OUTPUT SCHEME  0 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN


PROCESS  27    *** LAUNCH                                ***
 ACTIVITY COST TRANSFORMATION  6 HAS 13 DESCRIPTORS.
    13006.00,   254.86,  3200.00,   890.91,  3200.00,   280.00,  3200.00,  1113.64,  3200.00,
      280.00,  6000.00,  1113.64,  6000.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  IT IS LOCATED AT POSITION  396 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       1.00,     0.00,     0.00,     0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   24,
 THE  1 OUTPUT PROCESSES ARE   39,
   OUTPUT SCHEME  0 IS USED
  1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
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PROCESS  30    *** SRU PAYLOAD HOLD/RELEASE                ***
   IT IS LOCATED AT POSITION   98 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 40 HAS  2 DESCRIPTORS.
        0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE    42,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  2 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  31    *** DUMMY INSERT SHUTTLES                   ***
   IT IS LOCATED AT POSITION  224 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       -0.00,     -0.00,     -0.00,     -0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   -1,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  0 IS USED
   4 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  4 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS CLOSED

PROCESS  32    *** SATELLITE HOLD/RELEASE                  ***
   IT IS LOCATED AT POSITION  512 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 35 HAS  5 DESCRIPTORS.
        0.00,       0.00,       0.00,       0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE     1,    10,     3,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  2 IS USED
   0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  39    *** LAUNCH INTO ORBIT                       ***
   IT IS LOCATED AT POSITION  239 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 33 HAS  9 DESCRIPTORS.
```

1.00, .00, 0.00, 1.00, 0.00, 0.00, 2.00, 0.00, 0.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 27,
THE 5 OUTPUT PROCESSES ARE 199, 52, 45, 45, 45,
OUTPUT SCHEME 10 IS USED
1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

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PROCESS 42 *** SRU REPLACEMENT ***
IT IS LOCATED AT POSITION 530 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 37 HAS 5 DESCRIPTORS.
1.00, .00, 0.00, -1.00, 0.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 2,
THE 2 OUTPUT PROCESSES ARE 30, 2,
OUTPUT SCHEME 14 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 44 *** SPACECRAFT EQUIP. MFG ***
ACTIVITY COST TRANSFORMATION 5 HAS 2 DESCRIPTORS.
2005.00, .49,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
IT IS LOCATED AT POSITION 465 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 37 HAS 12 DESCRIPTORS.
1.00, .00, 0.00, 8.00, 1.00, 2.00, 3.00, 4.00, 5.00,
11.00, 13.00, 21.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 1,
THE 1 OUTPUT PROCESSES ARE 10,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 45 *** SHUTTLE/SATELLITE DISENGAGEMENT ***
IT IS LOCATED AT POSITION 279 OF THE INTERNAL COMPUTER LIST AREA.

```
PROCESS TRANSFORMATION TYPE 33 HAS 10 DESCRIPTORS.
      1.00,      .00,      0.00,      2.00,      0.00,      0.00,      3.00,      0.00,      0.00,
      0.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE   39,
THE  9 OUTPUT PROCESSES ARE   52,  191,  192,  -1,  192,  191,  52,  65,  66,
  OUTPUT SCHEME 10 IS USED
 1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN


PROCESS  52    *** RETURN FROM ORBIT                    ***
  IT IS LOCATED AT POSITION  263 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
      1.00,      8.00,      0.00,      0.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 2 INPUT PROCESSES ARE   39,   45,
THE  1 OUTPUT PROCESSES ARE   11,
  OUTPUT SCHEME  0 IS USED
 1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN


PROCESS  65    *** SATELLITE IN ORBIT                   ***
  IT IS LOCATED AT POSITION  126 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 36 HAS 10 DESCRIPTORS.
   87600.00,      0.00,      0.00,      1.00,      1.00,      0.00,      0.00,      0.00,      0.00,
      0.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE   45,
THE  4 OUTPUT PROCESSES ARE   65,  190,  193,  104,
  OUTPUT SCHEME 12 IS USED
 1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN


PROCESS  66    *** REPLACE SRU IN SPACE                 ***
  IT IS LOCATED AT POSITION   47 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 27 HAS  2 DESCRIPTORS.
```

.00, 65.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 45,
THE 1 OUTPUT PROCESSES ARE 52,
OUTPUT SCHEME 0 IS USED
1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

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PROCESS 79 *** GENERAL ORDER INSERTION ***
IT IS LOCATED AT POSITION 562 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
0.00, 0.00, 0.00, 0.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE -1,
THE 1 OUTPUT PROCESSES ARE 1,
OUTPUT SCHEME 0 IS USED
1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 1 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS CLOSED

PROCESS 103 *** DECISION MAKING ACTIVITY ***
IT IS LOCATED AT POSITION 150 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 2 HAS 4 DESCRIPTORS.
1.00, 0.00, 0.00, 0.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 3 INPUT PROCESSES ARE 199, 191, 190,
THE 1 OUTPUT PROCESSES ARE 2,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 104 *** ORBITAL OPER. PYLD ***
IT IS LOCATED AT POSITION 111 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 1 HAS 4 DESCRIPTORS.
1.00, 0.00, 0.00, 0.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 65,

```
THE  1 OUTPUT PROCESSES ARE     2,
  OUTPUT SCHEME  0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 190    *** FAILURE  SATELLITE IN ORBIT       ***
  IT IS LOCATED AT POSITION  451 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
       5.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 3 INPUT PROCESSES ARE   65,   -1,   -1,
THE  1 OUTPUT PROCESSES ARE  103,
  OUTPUT SCHEME  0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 191    *** SATELLITE LOST  DISENGAGEMENT     ***
  IT IS LOCATED AT POSITION  425 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
       2.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE   45,
THE  1 OUTPUT PROCESSES ARE  103,
  OUTPUT SCHEME  0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 192    *** SHUTTLE LOST  DISENGAGEMENT       ***
  IT IS LOCATED AT POSITION  308 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
       1.00,
  REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE   45,
THE  1 OUTPUT PROCESSES ARE   -1,
  OUTPUT SCHEME  0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
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INITIALLY, THERE ARE  C ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS CPEN

PROCESS 193    *** END OF MISSION                          ***
  IT IS LOCATED AT POSITION  437 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
        7.0C,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE   65,   -1,   -1,
 THE  1 CUTPUT PROCESSES ARE   -1,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS 197    *** COLLECT ALL SRU RETURNS                 ***
  IT IS LOCATED AT POSITION   6C OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
        7.0C,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE    5,
 THE  1 CUTPUT PROCESSES ARE   -1,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  C ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS 198    *** SATELLITE RETRIEVAL                     ***
  IT IS LOCATED AT POSITION    1 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
        7.0C,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE    5,
 THE  1 CUTPUT PROCESSES ARE   -1,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
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PROCESS 199    *** SHUTTLE LOST  LAUNCH              ***
  IT IS LOCATED AT POSITION  320 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
       3.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   39,
 THE  1 OUTPUT PROCESSES ARE  103,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN


            ***** SHUTTLE/SATELLITE/UNIT    DISPOSITION AT START *****


THE      ORDER 80001 IS SCHEDULED TO LEAVE PROCESS  79 AT      0.000 HOURS.


THE SHUTTLE  *0001 IS SCHEDULED TO LEAVE PROCESS  31 AT     0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD


THE SHUTTLE  *0002 IS SCHEDULED TO LEAVE PROCESS  31 AT     0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD


THE SHUTTLE  *0003 IS SCHEDULED TO LEAVE PROCESS  31 AT     0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD


THE SHUTTLE  *0004 IS SCHEDULED TO LEAVE PROCESS  31 AT     0.000 HOURS.
  THERE IS NO PAYLOAD ABOARD
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***** SRU/NRL UNIT CESCRIPTICN *****

NRU -------------SOLAR ARRAY^DRIVE MOCULE

MCDEL 1 SRU EQUIV. 1 WEIGHT 199 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10601.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	AD STR	92000.00 MFG.
10603.01	100000000	1.0000	ACTIVE 1.00	*00000.	THER	12000.00 MFG.
10651.03	4000000	1.0000	ACTIVE 1.00	*00000.	A DRIV	45000.00 MFG.
10651.03	4000000	1.0000	STNDBY .10	*00000.	A DRIV	45000.00 MFG.
10652.03	220410	1.0000	ACTIVE 1.00	*00000.	AD ELE	30000.00 MFG.
10652.03	220410	1.0000	STNDBY .10	*00000.	AD ELE	30000.00 MFG.
10631.02	288684	1.0000	ACTIVE 1.00	*00000.	DI/SCU	22000.00 MFG.
10631.02	288684	1.0000	STNDBY .10	*00000.	DI/SCU	22000.00 MFG.
10611.03	1176471	1.0000	ACTIVE 1.00	*00000.	AD PCU	25000.00 MFG.
10611.03	1176471	1.0000	STNDBY .10	*00000.	AD PCU	25000.00 MFG.
10653.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	ARRAY	528000.00 MFG.
10691.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	10000.00 MFG.

BUILD COST .0250 MILLION DOLLARS FACTORS MFG. 1.28 BUY 1.11

NRU ------------- ELECTRIC POWER MODULE

MODEL 2 SRU EQUIV. 1 WEIGHT 416 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10301.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	EP STR	19600.00 MFG.
10303.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
10311.03	400000	1.0000	ACTIVE 1.00	*00000.	EP PCU	25000.00 MFG.
10311.03	400000	1.0000	STNDBY .10	*00000.	EP PCU	25000.00 MFG.
10331.01	218341	1.0000	STNDBY .10	*00000.	DI/SCU	39000.00 MFG.
10331.01	218341	1.0000	ACTIVE 1.00	*00000.	DI/SCU	39000.00 MFG.
10351.03	1250000	1.0000	ACTIVE 1.00	*00000.	PCNTRL	65800.00 MFG.
10351.03	1250000	1.0000	STNDBY .10	*00000.	PCNTRL	65800.00 MFG.
20352.03	1754386	1.0000	ACTIVE 1.00	*00000.	BATTS	28800.00 BUY
20352.03	1754386	1.0000	ACTIVE 1.00	*00000.	BATTS	28800.00 BUY

20352.03	1754386	1.0000	ACTIVE 1.00	*00000.	BATTS	28800.00 BUY
10391.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	17000.00 MFG.

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------------OM≠D AND DATA HANDLING MODULE

MODEL 3 SRU EQUIV. 1 WEIGHT 170 NO. OF COMP. 25

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10201.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	CD STR	19600.00 MFG.
10203.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	13900.00 MFG.
10256.02	50000000	1.0000	ACTIVE 1.00	*00000.	OMNI	20000.00 BUY
10252.02	585480	1.0000	ACTIVE 1.00	*00000.	XMTR	43000.00 BUY
10252.02	585480	1.0000	STNDBY .10	*00000.	XMTR	43000.00 BUY
10251.02	248694	1.0000	ACTIVE 1.00	*00000.	RCVR	65000.00 BUY
10251.02	248694	1.0000	ACTIVE 1.00	*00000.	RCVR	65000.00 BUY
10253.02	8333333	1.0000	ACTIVE 1.00	*00000.	DIPLXR	32000.00 BUY
10273.02	2159827	1.0000	ACTIVE 1.00	*00000.	DECOD	30000.00 MFG.
10273.02	2159827	1.0000	ACTIVE 1.00	*00000.	DECODER	30000.00 MFG.
10274.02	273823	1.0000	ACTIVE 1.00	*00000.	BUSCON	20000.00 MFG.
10274.02	273823	1.0000	STNDBY .10	*00000.	BUSCON	20000.00 MFG.
10255.02	871840	1.0000	ACTIVE 1.00	*00000.	BB ASY	12000.00 MFG.
10255.02	871840	1.0000	STNDBY .10	*00000.	BB ASY	12000.00 MFG.
10211.02	400000	1.0000	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10211.02	400000	1.0000	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10254.02	4166667	1.0000	ACTIVE 1.00	*00000.	CMBSW	6500.00 BUY
10271.02	142857	1.0000	ACTIVE 1.00	*00000.	CPU	45000.00 BUY
10271.02	142857	1.0000	STNDBY .10	*00000.	CPU	45000.00 BUY
20272.02	291630	1.0000	ACTIVE 1.00	*00000.	MEM U	35000.00 BUY
20272.02	291630	1.0000	ACTIVE 1.00	*00000.	MEM U	35000.00 BUY
20272.02	291630	1.0000	STNDBY .10	*00000.	MEM U	35000.00 BUY
10231.02	292740	1.0000	ACTIVE 1.00	*00000.	DI/SCU	22000.00 MFG.
10231.02	292740	1.0000	STNDBY .10	*00000.	DI/SCU	22000.00 MFG.
10291.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	15000.00 MFG.

BUILD COST .0900 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU ------------- ATTITUDE DETERM. MODULE

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MODEL 4 SRU EQUIV. 1 WEIGHT 233 NO. OF COMP. 24

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10401.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	AD STR	19600.00 MFG.
10403.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	STNDBY .10	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	STNDBY .10	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	STNDBY .10	*00000.	GRA	80000.00 BUY
20452.01	190259	1.0000	ACTIVE 1.00	*00000.	STAR T	69000.00 BUY
20452.01	190259	1.0000	STNDBY .10	*00000.	STAR T	69000.00 BUY
20452.01	190259	1.0000	ACTIVE 1.00	*00000.	STAR T	69000.00 BUY
10453.02	714286	1.0000	ACTIVE 1.00	*00000.	MAGN	20000.00 BUY
10453.02	714286	1.0000	STNDBY .10	*00000.	MAGN	20000.00 BUY
10454.00	12500000	1.0000	ACTIVE 1.00	*00000.	SUN	44000.00 BUY
10471.02	105263	1.0000	ACTIVE 1.00	*00000.	XFER A	27500.00 MFG.
10471.02	105263	1.0000	STNDBY .10	*00000.	XFER A	27500.00 MFG.
10472.01	105263	1.0000	ACTIVE 1.00	*00000.	XFER B	27500.00 MFG.
10472.01	105263	1.0000	STNDBY .10	*00000.	XFER B	27500.00 MFG.
10473.00	2873563	1.0000	ACTIVE 1.00	*00000.	SAF MD	7000.00 MFG.
10411.03	400000	1.0000	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10411.03	400000	1.0000	STNDBY .10	*00000.	PCU	25000.00 MFG.
10431.02	215889	1.0000	ACTIVE 1.00	*00000.	DI/SCU	56000.00 MFG.
10431.02	215889	1.0000	STNDBY .10	*00000.	DI/SCU	56000.00 MFG.
10491.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	16000.00 MFG.

BUILD COST .0900 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------------ACTUATION MODULE

MODEL 5 SRU EQUIV. 1 WEIGHT 605 NO. OF COMP. 21

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10501.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	STRUC	24000.00 MFG.
10503.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
10504.02	100000000	1.0000	ACTIVE 1.00	*00000.	PTHER	11500.00 MFG.

10551.01	6666667	1.0000	ACTIVE 1.CO	*00000.	RRW	52000.00 BUY
10552.C1	6666667	1.0000	ACTIVE 1.CO	*00000.	PRW	52000.00 BUY
10553.C1	6666667	1.0000	ACTIVE 1.CO	*00000.	YRW	52000.00 BUY
10571.C1	309119	1.0000	ACTIVE 1.CO	*00C00.	RW EL	26000.00 MFG.
10571.C1	309119	1.0000	STNDBY .10	*00000.	RW EL	26000.00 MFG.
10572.C1	309119	1.0000	ACTIVE 1.CO	*00C00.	PW EL	26000.00 MFG.
10572.01	309119	1.0000	STNDBY .10	*00000.	PW EL	26000.00 MFG.
10573.01	309119	1.0000	ACTIVE 1.CO	*00000.	YW EL	26000.00 MFG.
10573.C1	309119	1.C000	STNDBY .10	*00000.	YW EL	26000.00 MFG.
10554.C1	10000000	1.C000	ACTIVE 1.CO	*00000.	RMT	8000.00 MFG.
10555.C1	10C00000	1.0000	ACTIVE 1.CO	*00C00.	PMT	8000.00 MFG.
10556.01	10000000	1.C000	ACTIVE 1.CO	*00C00.	YMT	8000.00 MFG.
10574.C1	370370	1.C000	ACTIVE 1.00	*00000.	MT EL	25000.00 MFG.
10531.02	215889	1.0000	ACTIVE 1.CO	*00C00.	DI/SCU	42000.00 MFG.
10531.C2	215889	1.C000	STNDBY .10	*00000.	DI/SCU	42000.00 MFG.
10557.C3	83333333	1.C000	ACTIVE 1.CO	*00000.	G N2	245000.00 MFG.
10558.02	2523977	1.0000	ACTIVE 1.CO	*00C00.	N2H4	175000.00 MFG.
10591.03	*000000000.	1.0000	ACTIVE 1.CO	*00000.	HARN	16000.00 MFG.

BUILD COST .0450 MILLICN CCLLARS FACTCRS MFG. 1.32 BUY 1.50

NRU -------------FIVE BANC MSS MPXR-A

MCDEL 11 SRU ECUIV. 1 WEIGHT 210 NO. OF COMP. 26

TYPE	ALPHA	BETA	CCNDITION	DSGN LIFE	COMP. NAME	COST(DCLLARS)
10931.01	207900	1.C000	ACTIVE 1.00	*00000.	MPXR	712000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CO	*00C00.	BND1	111000.00 BUY
40951.C1	1321004	1.0000	ACTIVE 1.CO	*00C00.	BND1	111000.00 BUY
40951.01	1321004	1.C000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.C000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.CO	*00000.	BND1	111000.00 BUY
40952.01	1321C04	1.0000	ACTIVE 1.00	*00C00.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.C000	ACTIVE 1.CO	*00C00.	BND2	111000.00 BUY
40952.C1	1321004	1.C000	ACTIVE 1.00	*00C00.	BND2	111000.00 BUY
40952.C1	1321004	1.C000	ACTIVE 1.CO	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.CC	*00C00.	BND2	111000.00 BUY
40953.01	1321C04	1.0000	ACTIVE 1.CO	*00C00.	BND3	111000.00 BUY

40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
10955.01	460405	1.0000	ACTIVE 1.00	*00000.	BND5	324000.00 BUY

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------------WIDEBAND CDH MODULE A

MODEL 13 SRU EQUIV. 1 WEIGHT 240 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10831.01	13157895	1.0000	ACTIVE 1.00	*00000.	HSMPX	3700.00 MFG.
10832.01	677966	1.0000	ACTIVE 1.00	*00000.	DATA PROCESSOR	72000.00 MFG.
10852.01	2702703	1.0000	ACTIVE 1.00	*00000.	P AMP	18100.00 MFG.
10853.01	9615385	1.0000	ACTIVE 1.00	*00000.	ANTEN	5100.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
10731.01	181818	1.0000	ACTIVE 1.00	*00000.	VTR	400000.00 BUY
10731.01	181818	1.0000	STNDBY .10	*00000.	VTR	400000.00 BUY

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------------NON-REPLACEABLE COMPONENTS

MODEL 21 SRU EQUIV. 1 WEIGHT 506 NO. OF COMP. 9

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10001.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	STRUCT	88900.00 MFG.
10002.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL STRUCTURE	287000.00 MFG.
10041.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	T RING	7600.00 MFG.
10061.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	ADAPT.	25200.00 MFG.
10071.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	MECHANISMS	16100.00 MFG.
10003.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	SC THERMAL	118000.00 MFG.
10021.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL THERMAL	233000.00 MFG.
10091.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	SC HARNESS	10000.00 MFG.
10081.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL HARNESS	10000.00 MFG.

BUILD COST .0600 MILLION DOLLARS FACTORS MFG. 1.28 BUY 1.11

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      ***** TIME LINE ANALYSIS DESCRIPTION *****

       THERE IS NO TIME LINE ANALYSIS  INPUT
      ITEM     40000004 ENTERED PROCESS       19 AT        0.000 HOURS
      ITEM     30000003 ENTERED PROCESS       19 AT        0.000 HOURS
      ITEM     20000002 ENTERED PROCESS       19 AT        0.000 HOURS
      ITEM     10000001 ENTERED PROCESS       19 AT        0.000 HOURS
      ITEM        80001 ENTERED PROCESS        1 AT        0.000 HOURS
      ITEM        80001 ENTERED PROCESS        1 AT        0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
      ITEM        80002 ENTERED PROCESS        1 AT        0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
      ITEM        80003 ENTERED PROCESS        1 AT        0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
      ITEM        80003 ENTERED PROCESS       32 AT        0.000 HOURS
      ITEM        80002 ENTERED PROCESS       32 AT        0.000 HOURS
      ITEM        80001 ENTERED PROCESS       44 AT        0.000 HOURS
      ITEM *       1001 ENTERED PROCESS       44 AT        0.000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
      ITEM *       2001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *       3001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *       4001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *       5001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *      11001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *      13001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *      21001 ENTERED PROCESS      198 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *       1001 ENTERED PROCESS        0 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *     200001 ENTERED PROCESS       10 AT         .000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
      ITEM *     200001 ENTERED PROCESS       32 AT         .000 HOURS
      ITEM *     200001 ENTERED PROCESS       32 AT         .000 HOURS
      ITEM *      80002 ENTERED PROCESS        0 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM *     200001 ENTERED PROCESS       32 AT         .000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
      ITEM        80003 ENTERED PROCESS       32 AT         .000 HOURS
      ITEM * 40000004 ENTERED PROCESS       19 AT         .000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM *     200001 ENTERED PROCESS        5 AT       -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
      ITEM * 40000004 ENTERED PROCESS       24 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM * 40000004 ENTERED PROCESS       27 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM * 40000004 ENTERED PROCESS       39 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM *     200001 ENTERED PROCESS       45 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM     40000004 ENTERED PROCESS       45 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
      ITEM *     201001 ENTERED PROCESS       65 AT      730.000 HOURS AND IS SCHEDULED TO FINISH AT   9299.948 HOUR
 0          0.0         0.0    0.000000          0    9999999         0    0
 1        730.0         0.0    0.000000          0    9999999         0    1
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     ITEM    40000004 ENTERED PROCESS       52 AT     730.000 HOURS AND IS SCHEDULED TO FINISH AT     738.000 HOUR
     ITEM    40000004 ENTERED PROCESS       11 AT     738.000 HOURS AND IS SCHEDULED TO FINISH AT     747.600 HOUR
     ITEM    40000004 ENTERED PROCESS       13 AT     747.600 HOURS AND IS SCHEDULED TO FINISH AT     808.400 HOUR
     ITEM    40000004 ENTERED PROCESS       19 AT     808.400 HOURS
     ITEM *    201001 ENTERED PROCESS       65 AT    9298.948 HOURS AND IS SCHEDULED TO FINISH AT   10558.259 HOUR
     ITEM       80001 ENTERED PROCESS       65 AT    9298.948 HOURS AND IS SCHEDULED TO FINISH AT    9298.948 HOUR
 1.600126E+06  8.010000E+02  1.063102E+06  1.001002E+06  2.886830E+06
 1.000000E+00
     ITEM       80001 ENTERED PROCESS      104 AT    9298.948 HOURS AND IS SCHEDULED TO FINISH AT    9298.948 HOUR
     ITEM       80001 ENTERED PROCESS        2 AT    9298.948 HOURS
     ITEM *    201001 ENTERED PROCESS       65 AT   10558.259 HOURS AND IS SCHEDULED TO FINISH AT   16957.931 HOUR
     ITEM       80001 ENTERED PROCESS       65 AT   10558.259 HOURS AND IS SCHEDULED TO FINISH AT   10558.259 HOUR
 1.600126E+06  9.010000E+02  2.035203E+06  1.002003E+06  8.771920E+06
 1.000000E+00
     ITEM       80001 ENTERED PROCESS      104 AT   10558.259 HOURS AND IS SCHEDULED TO FINISH AT   10558.259 HOUR
     ITEM       80001 ENTERED PROCESS        2 AT   10558.259 HOURS
     ITEM *    201001 ENTERED PROCESS       65 AT   16957.931 HOURS AND IS SCHEDULED TO FINISH AT   47348.978 HOUR
     ITEM       80001 ENTERED PROCESS       65 AT   16957.931 HOURS AND IS SCHEDULED TO FINISH AT   16957.931 HOUR
 1.600126E+06  1.101000E+03  2.045201E+06  1.002003E+06  9.512900E+05
 1.000000E+00
     ITEM       80001 ENTERED PROCESS      104 AT   16957.931 HOURS AND IS SCHEDULED TO FINISH AT   16957.931 HOUR
     ITEM       80001 ENTERED PROCESS        2 AT   16957.931 HOURS
     ITEM *    201001 ENTERED PROCESS       65 AT   47348.978 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80001 ENTERED PROCESS       65 AT   47348.978 HOURS AND IS SCHEDULED TO FINISH AT   47348.978 HOUR
 1.600126E+06  1.101000E+03  1.047102E+06  1.001002E+06  1.052630E+06
 1.000000E+00
     ITEM       80001 ENTERED PROCESS      104 AT   47348.978 HOURS AND IS SCHEDULED TO FINISH AT   47348.978 HOUR
     ITEM       80001 ENTERED PROCESS        2 AT   47348.978 HOURS
 0     50859.6          0.0    0.000000        0     9999999          0    0
 1         0.0      50129.6    1.000000    50130       50130          0    1
     ITEM *    201001 ENTERED PROCESS      190 AT   50859.592 HOURS
     ITEM       80002 ENTERED PROCESS      190 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80002 ENTERED PROCESS      103 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80002 ENTERED PROCESS        2 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80002 ENTERED PROCESS        1 AT   50859.592 HOURS
     ITEM       80001 ENTERED PROCESS        1 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80003 ENTERED PROCESS        1 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80002 ENTERED PROCESS        1 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
     ITEM       80002 ENTERED PROCESS       32 AT   50859.592 HOURS
     ITEM       80003 ENTERED PROCESS       32 AT   50859.592 HOURS
     ITEM       80001 ENTERED PROCESS       44 AT   50859.592 HOURS
     ITEM *      1002 ENTERED PROCESS       44 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
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ORIGINAL PAGE IS OF POOR QUALITY

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    ITEM *       2002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *       3002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *       4002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *       5002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *      11002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *      13002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *      21002 ENTERED PROCESS    198 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *       1002 ENTERED PROCESS      0 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *     200002 ENTERED PROCESS     10 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
    ITEM *     200002 ENTERED PROCESS     32 AT   50859.592 HOURS
    ITEM *     200002 ENTERED PROCESS     32 AT   50859.592 HOURS
    ITEM *      80002 ENTERED PROCESS      0 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM *     200002 ENTERED PROCESS     32 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   50859.592 HOUR
    ITEM        80003 ENTERED PROCESS     32 AT   50859.592 HOURS
    ITEM * 30000003 ENTERED PROCESS       19 AT   50859.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM *     200002 ENTERED PROCESS      4 AT      -1.000 HOURS AND IS SCHEDULED TO FINISH AT      -1.000 HOUR
    ITEM * 30000003 ENTERED PROCESS       24 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM * 30000003 ENTERED PROCESS       27 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM * 30000003 ENTERED PROCESS       39 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM *     200002 ENTERED PROCESS     45 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM   30000003 ENTERED PROCESS       45 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51589.592 HOUR
    ITEM *     201002 ENTERED PROCESS     65 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   55853.247 HOUR
0         0.0       730.0     .014353      730        730          0    0
1     51589.6     50129.6     .985647    50130      50130          0    1
    ITEM   30000003 ENTERED PROCESS       52 AT   51589.592 HOURS AND IS SCHEDULED TO FINISH AT   51597.592 HOUR
    ITEM   30000003 ENTERED PROCESS       11 AT   51597.592 HOURS AND IS SCHEDULED TO FINISH AT   51607.192 HOUR
    ITEM   30000003 ENTERED PROCESS       13 AT   51607.192 HOURS AND IS SCHEDULED TO FINISH AT   51667.992 HOUR
    ITEM   30000003 ENTERED PROCESS       19 AT   51667.992 HOURS
    ITEM *     201002 ENTERED PROCESS     65 AT   55853.247 HOURS AND IS SCHEDULED TO FINISH AT   57494.246 HOUR
    ITEM        80001 ENTERED PROCESS     65 AT   55853.247 HOURS AND IS SCHEDULED TO FINISH AT   55853.247 HOUR
 2.500126E+06  1.701000E+03  1.065203E+06  1.001002E+06  2.204090E+06
 1.000000E+00
    ITEM        80001 ENTERED PROCESS    104 AT   55853.247 HOURS AND IS SCHEDULED TO FINISH AT   55853.247 HOUR
    ITEM        80001 ENTERED PROCESS      2 AT   55853.247 HOURS
    ITEM *     201002 ENTERED PROCESS     65 AT   57494.246 HOURS AND IS SCHEDULED TO FINISH AT   59776.136 HOUR
    ITEM        80001 ENTERED PROCESS     65 AT   57494.246 HOURS AND IS SCHEDULED TO FINISH AT   57494.246 HOUR
 2.500126E+06  2.001000E+03  3.045102E+06  1.003006E+06  9.999999E+07
 1.000000E+00
    ITEM        80001 ENTERED PROCESS    104 AT   57494.246 HOURS AND IS SCHEDULED TO FINISH AT   57494.246 HOUR
    ITEM        80001 ENTERED PROCESS      2 AT   57494.246 HOURS
0     59776.1       730.0     .012363      730        730          0    0
1         0.0     58316.1     .987637    50130       8187          0    1
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ITEM *   201002 ENTERED PROCESS    190 AT  59776.136 HOURS
ITEM      80002 ENTERED PROCESS    190 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80002 ENTERED PROCESS    103 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80002 ENTERED PROCESS      2 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80002 ENTERED PROCESS      1 AT  59776.136 HOURS
ITEM      80001 ENTERED PROCESS      1 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80003 ENTERED PROCESS      1 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80002 ENTERED PROCESS      1 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80002 ENTERED PROCESS     32 AT  59776.136 HOURS
ITEM      80003 ENTERED PROCESS     32 AT  59776.136 HOURS
ITEM      80001 ENTERED PROCESS     44 AT  59776.136 HOURS
ITEM *     1003 ENTERED PROCESS     44 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM *     2003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     3003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     4003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     5003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *    11003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *    13003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *    21003 ENTERED PROCESS    198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     1003 ENTERED PROCESS      0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *   200003 ENTERED PROCESS     10 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM *   200003 ENTERED PROCESS     32 AT  59776.136 HOURS
ITEM *   200003 ENTERED PROCESS     32 AT  59776.136 HOURS
ITEM *    80002 ENTERED PROCESS      0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *   200003 ENTERED PROCESS     32 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  59776.136 HOUR
ITEM      80003 ENTERED PROCESS     32 AT  59776.136 HOURS
ITEM * 20000002 ENTERED PROCESS     19 AT  59776.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM *   200003 ENTERED PROCESS      3 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM * 20000002 ENTERED PROCESS     24 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM * 20000002 ENTERED PROCESS     27 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM * 20000002 ENTERED PROCESS     39 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM *   200003 ENTERED PROCESS     45 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM   20000002 ENTERED PROCESS     45 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60506.136 HOUR
ITEM *   201003 ENTERED PROCESS     65 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  66035.254 HOUR
0        0.0      1460.0   .024424    730      730        0    0
1    60506.1     58316.1   .975576  50130     8187        0    1
ITEM   20000002 ENTERED PROCESS     52 AT  60506.136 HOURS AND IS SCHEDULED TO FINISH AT  60514.136 HOUR
ITEM   20000002 ENTERED PROCESS     11 AT  60514.136 HOURS AND IS SCHEDULED TO FINISH AT  60523.736 HOUR
ITEM   20000002 ENTERED PROCESS     13 AT  60523.736 HOURS AND IS SCHEDULED TO FINISH AT  60584.536 HOUR
ITEM   20000002 ENTERED PROCESS     19 AT  60584.536 HOURS
ITEM *   201003 ENTERED PROCESS     65 AT  66035.254 HOURS AND IS SCHEDULED TO FINISH AT  69579.776 HOUR
ITEM      80001 ENTERED PROCESS     65 AT  66035.254 HOURS AND IS SCHEDULED TO FINISH AT  66035.254 HOUR
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3.400126E+06  3.101000E+03  4.095401E+06  1.004006E+06  9.999999E+07
1.000000E+00
     ITEM       80001 ENTERED PROCESS     104 AT  66035.254 HOURS AND IS SCHEDULED TO FINISH AT  66035.254 HOUR
     ITEM       80001 ENTERED PROCESS       2 AT  66035.254 HOURS
     ITEM *    201003 ENTERED PROCESS      65 AT  69579.776 HOURS AND IS SCHEDULED TO FINISH AT  73828.061 HOUR
     ITEM       80001 ENTERED PROCESS      65 AT  69579.776 HOURS AND IS SCHEDULED TO FINISH AT  69579.776 HOUR
3.400126E+06  2.901000E+03  3.045102E+06  1.003006E+06  9.999999E+07
1.000000E+00
     ITEM       80001 ENTERED PROCESS     104 AT  69579.776 HOURS AND IS SCHEDULED TO FINISH AT  69579.776 HOUR
     ITEM       80001 ENTERED PROCESS       2 AT  69579.776 HOURS
     ITEM *    201003 ENTERED PROCESS      65 AT  73828.061 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80001 ENTERED PROCESS      65 AT  73828.061 HOURS AND IS SCHEDULED TO FINISH AT  73828.061 HOUR
3.400126E+06  2.901000E+03  2.045201E+06  1.002003E+06  9.512900E+05
1.000000E+00
     ITEM       80001 ENTERED PROCESS     104 AT  73828.061 HOURS AND IS SCHEDULED TO FINISH AT  73828.061 HOUR
     ITEM       80001 ENTERED PROCESS       2 AT  73828.061 HOURS
0     77554.2      1460.0     .019004      730       730       0    0
1         0.0     75364.2     .980956    50130      8187       0    1
     ITEM *    201003 ENTERED PROCESS     190 AT  77554.232 HOURS
     ITEM       80002 ENTERED PROCESS     190 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80002 ENTERED PROCESS     103 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80002 ENTERED PROCESS       2 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80002 ENTERED PROCESS       1 AT  77554.232 HOURS
     ITEM       80001 ENTERED PROCESS       1 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80003 ENTERED PROCESS       1 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80002 ENTERED PROCESS       1 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM       80002 ENTERED PROCESS      32 AT  77554.232 HOURS
     ITEM       80003 ENTERED PROCESS      32 AT  77554.232 HOURS
     ITEM       80001 ENTERED PROCESS      44 AT  77554.232 HOURS
     ITEM *      1004 ENTERED PROCESS      44 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM *      2004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *      3004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *      4004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *      5004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *     11004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *     13004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *     21004 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *      1004 ENTERED PROCESS       0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
     ITEM *    200004 ENTERED PROCESS      10 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
     ITEM *    200004 ENTERED PROCESS      32 AT  77554.232 HOURS
     ITEM *    200004 ENTERED PROCESS      32 AT  77554.232 HOURS
     ITEM *     80002 ENTERED PROCESS       0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
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   ITEM *    200004 ENTERED PROCESS      32 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  77554.232 HOUR
   ITEM       80003 ENTERED PROCESS      32 AT  77554.232 HOURS
   ITEM * 10000001 ENTERED PROCESS      19 AT  77554.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM *    200004 ENTERED PROCESS       2 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM * 10000001 ENTERED PROCESS      24 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM * 10000001 ENTERED PROCESS      27 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM * 10000001 ENTERED PROCESS      39 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM *    200004 ENTERED PROCESS      45 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM    10000001 ENTERED PROCESS      45 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78284.232 HOUR
   ITEM *    201004 ENTERED PROCESS      65 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  81068.253 HOUR
0       0.0      2190.0    .028238     730       730         0    0
1   78284.2     75364.2    .971762   50130      8187         0    1
   ITEM    10000001 ENTERED PROCESS      52 AT  78284.232 HOURS AND IS SCHEDULED TO FINISH AT  78292.232 HOUR
   ITEM    10000001 ENTERED PROCESS      11 AT  78292.232 HOURS AND IS SCHEDULED TO FINISH AT  78301.832 HOUR
   ITEM    10000001 ENTERED PROCESS      13 AT  78301.832 HOURS AND IS SCHEDULED TO FINISH AT  78362.632 HOUR
   ITEM    10000001 ENTERED PROCESS      19 AT  78362.632 HOURS
   ITEM *    201004 ENTERED PROCESS      65 AT  81068.253 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80001 ENTERED PROCESS      65 AT  81068.253 HOURS AND IS SCHEDULED TO FINISH AT  81068.253 HOUR
4.300126E+06  3.901000E+03  1.053102E+06  1.001002E+06  2.158890E+06
1.000000E+00
   ITEM       80001 ENTERED PROCESS     104 AT  81068.253 HOURS AND IS SCHEDULED TO FINISH AT  81068.253 HOUR
   ITEM       80001 ENTERED PROCESS       2 AT  81068.253 HOURS
0   82595.1      2190.0    .026751     730       730         0    0
1       0.0     79675.1    .973249   50130      4311         0    1
   ITEM *    201004 ENTERED PROCESS     190 AT  82595.060 HOURS
   ITEM       80002 ENTERED PROCESS     190 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80002 ENTERED PROCESS     103 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80002 ENTERED PROCESS       2 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80002 ENTERED PROCESS       1 AT  82595.060 HOURS
   ITEM       80001 ENTERED PROCESS       1 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80003 ENTERED PROCESS       1 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80002 ENTERED PROCESS       1 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM       80002 ENTERED PROCESS      32 AT  82595.060 HOURS
   ITEM       80003 ENTERED PROCESS      32 AT  82595.060 HOURS
   ITEM       80001 ENTERED PROCESS      44 AT  82595.060 HOURS
   ITEM *      1005 ENTERED PROCESS      44 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
   ITEM *      2005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM *      3005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM *      4005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM *      5005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM *     11005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
   ITEM *     13005 ENTERED PROCESS     198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
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ITEM *      21005 ENTERED PROCESS    158 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *       1005 ENTERED PROCESS      0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     200005 ENTERED PROCESS     10 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
ITEM *     200005 ENTERED PROCESS     32 AT  82595.060 HOURS
ITEM *     200005 ENTERED PROCESS     32 AT  82595.060 HOURS
ITEM *      80002 ENTERED PROCESS      0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     200005 ENTERED PROCESS     32 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  82595.060 HOUR
ITEM        80003 ENTERED PROCESS     32 AT  82595.060 HOURS
ITEM * 40000004 ENTERED PROCESS       19 AT  82595.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM *     200005 ENTERED PROCESS      5 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM * 40000004 ENTERED PROCESS       24 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM * 40000004 ENTERED PROCESS       27 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM * 40000004 ENTERED PROCESS       39 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM *     200005 ENTERED PROCESS     45 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM   40000004 ENTERED PROCESS       45 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83325.060 HOUR
ITEM *     201005 ENTERED PROCESS     65 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  84872.891 HOUR
0        0.0      2920.0     .035353      730       730           0    0
1    83325.1     79675.1     .964647    50130      4311           0    1
ITEM   40000004 ENTERED PROCESS       52 AT  83325.060 HOURS AND IS SCHEDULED TO FINISH AT  83333.060 HOUR
ITEM   40000004 ENTERED PROCESS       11 AT  83333.060 HOURS AND IS SCHEDULED TO FINISH AT  83342.660 HOUR
ITEM   40000004 ENTERED PROCESS       13 AT  83342.660 HOURS AND IS SCHEDULED TO FINISH AT  83403.460 HOUR
ITEM   40000004 ENTERED PROCESS       19 AT  83403.460 HOURS
ITEM *     201005 ENTERED PROCESS     65 AT  84872.891 HOURS AND IS SCHEDULED TO FINISH AT  86691.545 HOUR
ITEM        80001 ENTERED PROCESS     65 AT  84872.891 HOURS AND IS SCHEDULED TO FINISH AT  84872.891 HOUR
5.200126E+06  4.701000E+03  1.043102E+06  1.001002E+06  2.158890E+06
1.000000E+00
ITEM        80001 ENTERED PROCESS    104 AT  84872.891 HOURS AND IS SCHEDULED TO FINISH AT  84872.891 HOUR
ITEM        80001 ENTERED PROCESS      2 AT  84872.891 HOURS
ITEM *     201005 ENTERED PROCESS     65 AT  86691.545 HOURS AND IS SCHEDULED TO FINISH AT  91187.212 HOUR
ITEM        80001 ENTERED PROCESS     65 AT  86691.545 HOURS AND IS SCHEDULED TO FINISH AT  86691.545 HOUR
5.200126E+06  4.701000E+03  3.045102E+06  1.003006E+06  9.999999E+07
1.000000E+00
ITEM        80001 ENTERED PROCESS    104 AT  86691.545 HOURS AND IS SCHEDULED TO FINISH AT  86691.545 HOUR
ITEM        80001 ENTERED PROCESS      2 AT  86691.545 HOURS
ITEM *     201005 ENTERED PROCESS    193 AT  88330.000 HOURS
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SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	0 SAT.	SIMULATION NO.
1	4	0	96.667	3.333	1
2	2	0	98.333	1.667	2
3	3	0	97.500	2.500	3
4	5	0	95.833	4.167	4
5	1	0	99.167	.833	5
6	2	0	98.333	1.667	6
7	4	0	96.667	3.333	7
8	0	0	100.000	0.000	8
9	5	0	95.833	4.167	9
10	4	0	96.667	3.333	10
11	2	0	98.333	1.667	11
12	4	0	96.667	3.333	12
13	2	0	98.333	1.667	13
14	2	0	98.333	1.667	14
15	2	0	98.333	1.667	15
16	3	0	97.500	2.500	16
17	3	0	97.500	2.500	17
18	1	0	99.167	.833	18
19	2	0	98.333	1.667	19
20	2	0	98.333	1.667	20
21	2	0	98.333	1.667	21
22	3	0	97.500	2.500	22
23	1	0	99.167	.833	23
24	2	0	98.333	1.667	24
25	2	0	98.333	1.667	25
26	7	0	94.167	5.833	26
27	0	0	100.000	0.000	27
28	1	0	99.167	.833	28
29	2	0	98.333	1.667	29
30	3	0	97.500	2.500	30
31	1	0	99.167	.833	31
32	2	0	98.333	1.667	32
33	3	0	97.500	2.500	33
34	2	0	98.333	1.667	34
35	3	0	97.500	2.500	35

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SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	OPERATING PERCENTAGE 0 SAT.	SIMULATION NO.
36	1	0	99.167	.833	36
37	5	0	95.833	4.167	37
38	4	0	96.667	3.333	38
39	3	0	97.500	2.500	39
40	4	0	96.667	3.333	40
41	1	0	99.167	.833	41
42	3	0	97.500	2.500	42
43	2	0	98.333	1.667	43
44	4	0	96.667	3.333	44
45	3	0	97.500	2.500	45
46	2	0	98.333	1.667	46
47	2	0	98.333	1.667	47
48	4	0	96.667	3.333	48
49	1	0	99.167	.833	49
50	3	0	97.500	2.500	50
51	3	0	97.500	2.500	51
52	2	0	98.333	1.667	52
53	2	0	98.333	1.667	53
54	2	0	98.333	1.667	54
55	2	0	97.562	2.438	55
56	2	0	98.333	1.667	56
57	1	0	99.167	.833	57
58	3	0	97.500	2.500	58
59	3	0	97.500	2.500	59
60	3	0	97.500	2.500	60
61	4	0	96.667	3.333	61
62	2	0	98.333	1.667	62
63	3	0	97.500	2.500	63
64	2	0	98.333	1.667	64
65	2	0	98.333	1.667	65
66	3	0	97.500	2.500	66
67	2	0	98.333	1.667	67
68	4	0	96.667	3.333	68
69	3	0	97.500	2.500	69
70	2	0	98.333	1.667	70

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SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	0 SAT.	SIMULATION NO.
71	4	0	96.667	3.333	71
72	1	0	99.167	.833	72
73	2	0	98.333	1.667	73
74	1	0	99.167	.833	74
75	3	0	97.500	2.500	75
76	2	0	98.333	1.667	76
77	1	0	99.167	.833	77
78	1	0	99.167	.833	78
79	3	0	97.500	2.500	79
80	4	0	96.667	3.333	80
81	2	0	98.333	1.667	81
82	3	0	97.500	2.500	82
83	3	0	97.500	2.500	83
84	3	0	97.500	2.500	84
85	4	0	96.667	3.333	85
86	5	0	95.833	4.167	86
87	2	0	97.994	2.006	87
88	1	0	99.167	.833	88
89	2	0	98.333	1.667	89
90	3	0	97.500	2.500	90
91	2	0	98.333	1.667	91
92	3	0	97.500	2.500	92
93	3	0	97.500	2.500	93
94	1	0	99.167	.833	94
95	1	0	99.167	.833	95
96	2	0	98.333	1.667	96
97	2	0	98.333	1.667	97
98	2	0	98.333	1.667	98
99	2	0	98.333	1.667	99
100	2	0	98.333	1.667	100

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***** AVAILABILITY *****

THERE WERE 100 MISSIONS WHICH ACCUMULATED 8760000 OPERATING HOURS IN ORBIT.

THERE ARE 0 SATELLITES OPERATING FOR 2.086 PERCENT OF THE TIME.

MINIMUM	0.00	PERCENT
AVERAGE	2.09	PERCENT
MAXIMUM	5.83	PERCENT
STANDARD DEVIATION	.98	PERCENT

THERE ARE 1 SATELLITES OPERATING FOR 97.914 PERCENT OF THE TIME.

MINIMUM	94.17	PERCENT
AVERAGE	97.91	PERCENT
MAXIMUM	100.00	PERCENT
STANDARD DEVIATION	.98	PERCENT

*** FREQUENCY DISTRIBUTION OF SHUTTLE LAUNCHES REQUIRED ***

LAUNCHES	0	1	2	3	4	5	6	7	8	9
OCCURNC	0	2	16	38	26	13	4	0	1	0
NORM	0.00	.05	.42	1.00	.68	.34	.11	0.00	.03	0.00
CUM	0.00	.02	.18	.56	.82	.95	.99	.99	1.00	1.00
LAUNCHES	0	1	2	3	4	5	6	7	8	9

MINIMUM	=	1.00
AVERAGE	=	3.49
MAXIMUM	=	8.00
MEDIAN	=	3.00
MODE	=	3.00
STANDARD DEVIATION	=	1.18

*** SHUTTLE LAUNCH TIME DISTRIBUTION ***

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED IN EACH TIME INTERVAL.

THE TOTAL TIME SPANNED IS 131400.0 HOURS.

EACH INTERVAL IS 2190.0 HOURS.

AVG. NO.	1.01	.03	.02	.08	.01	.02	.06	.06	.05	.05	.03	.07	.06	.07	.11	.07	.04	.05	.04	.07
INTERVAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

AVG. NO.	.05	.07	.11	.12	.07	.09	.04	.10	.07	.06	.04	.09	.05	.07	.10	.04	.07	.07	.11	.04
INTERVAL	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

AVG. NO.	.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INTERVAL	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

THE MIN. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 1.00

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 3.49

THE MAX. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 8.00

LOW ALTITUDE LAUNCHES PER MISSION

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

HIGH ALTITUDE LAUNCHES PER MISSION

MINIMUM = 0.00
AVERAGE = 0.00
MAXIMUM = 0.00
STD DEV = 0.00

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***** SERVICE FLIGHT INITIATION STATISTICS *****

SATELLITE DOWN

    MINIMUM =     0.00
    AVERAGE =     0.00
    MAXIMUM =     0.00
    STD DEV =     0.00

TUG WEIGHT LIMIT REACHED

    MINIMUM =     0.00
    AVERAGE =     0.00
    MAXIMUM =     0.00
    STD DEV =     0.00

STORAGE LIMIT REACHED

    MINIMUM =     0.00
    AVERAGE =     0.00
    MAXIMUM =     0.00
    STD DEV =     0.00

    *** SRU REPLACEMENT PER SERVICE FLIGHT DISTRIBUTION ***

THERE WERE NO ENTRIES IN THE DISTRIBUTION

    *** SRU REPLACEMENT WEIGHT DISTRIBUTION PER SERVICE FLIGHT ***

THERE WERE NO ENTRIES IN THE DISTRIBUTION
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*** REPLACEMENT SATELLITES MISSICN FREQLENCY DISTRIBUTION ***

SATELLIT	0	1	2	3	4	5	6	7	8
OCCURNC	2	16	38	26	13	4	0	1	0
NORM	.05	.42	1.00	.68	.34	.11	0.00	.03	C.00
CUM	.02	.18	.56	.82	.95	.99	.99	1.00	1.00
SATELLIT	0	1	2	3	4	5	6	7	8

MINIMUM = 0.00

AVERAGE = 2.49

MAXIMUM = 7.00

MEDIAN = 2.00

MODE = 2.00

STANDARD CEVIATION = 1.18

*** SRU MODELS DOWN SUMMARY ***

THERE WERE NO ENTRIES IN THE DISTRIBUTION

*** SRU MODELS REWORKED ***

THERE WERE NO ENTRIES IN THE DISTRIBUTION

***** SATELLITE SERVICE VISITS *****

*** NUMBER OF SATELLITES VISITED PER MISSION ****

THERE WERE NO ENTRIES IN THE DISTRIBUTION

***** ACTIVITY COST SUMMARY *****

ID	NAME/DESCRIPTION	START HRS *	FINISH HRS *	COST (MILLIONS OF DOLLARS) MIN	AVG	MAX	STD DEV
27	LAUNCH	-1.0	-1.0	1.531	5.344	12.250	1.805
44	SPACECRAFT EQUIP. MFG	-1.0	-1.0	12.125	42.315	96.998	14.294
	**** ACTIVITY TOTALS ****			13.656	47.659	109.248	16.100

* TYPICAL TIME FOR 1ST ITEM ENTRY AND LAST ITEM COMPLETION FOR MISSION SIMULATION 100

*** MISSION COST (MILLIONS) ***

COST DLR	10	20	30	40	50	60	70	80	90	100	110	120
OCCURNC	0	2	16	0	38	26	13	0	4	0	1	0
NORM	0.00	.05	.42	0.00	1.00	.68	.34	0.00	.11	0.00	.03	0.00
CUM	0.00	.02	.18	.18	.56	.82	.95	.95	.99	.99	1.00	1.00
COST DLR	10	20	30	40	50	60	70	80	90	100	110	120

MINIMUM = 20.00

AVERAGE = 53.60

MAXIMUM = 110.00

MEDIAN = 50.00

MODE = 50.00

STANDARD DEVIATION = 15.72

NRU MODEL NUMBER 1 - SOLAR ARRAY DRIVE MODULE

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

B-35

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00

AVERAGE = 0.00

MAXIMUM = 0.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = 0.00

UNITS MANUFACTURED

MINIMUM	=	1.00
AVERAGE	=	3.49
MAXIMUM	=	8.00
STD DEV	=	1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM	=	0.00
AVERAGE	=	0.00
MAXIMUM	=	0.00
MEDIAN	=	0.00
MODE	=	0.00
STANDARD DEVIATION	=	0.00

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURRNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00

AVERAGE = 0.00

MAXIMUM = 0.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = 0.00

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00
AVERAGE = 0.00
MAXIMUM = 0.00
MEDIAN = 0.00
MODE = 0.00
STANDARD DEVIATION = 0.00

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00

AVERAGE = 0.00

MAXIMUM = 0.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = 0.00

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00
AVERAGE = 0.00
MAXIMUM = 0.00
MEDIAN = 0.00
MODE = 0.00
STANDARD DEVIATION = 0.00

NRC MODEL NUMBER 13 - WIDEBAND CDH MODULE A

UNITS MANUFACTURED

MINIMUM	=	1.00
AVERAGE	=	3.49
MAXIMUM	=	8.00
STD DEV	=	1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM	=	0.00
AVERAGE	=	0.00
MAXIMUM	=	0.00
MEDIAN	=	0.00
MODE	=	0.00
STANDARD DEVIATION	=	0.00

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.49
MAXIMUM = 8.00
STD DEV = 1.18

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00
AVERAGE = 0.00
MAXIMUM = 0.00
MEDIAN = 0.00
MODE = 0.00
STANDARD DEVIATION = 0.00

34 3183

UCG5800. 09/12/74. TRW/TSS 7418 - 09/03/74.

```
18.18.20.JOB,UCG5800.
18.18.20.ACCOUNT,JW65705.
18.18.21.NAME,228600,65705,WROBLESKI,J.
18.18.21.PROBLEM,243761.
18.18.21.MACHINE,7418.
18.18.21.MAXFL,204000.
18.18.21.MAXTIM,100.
18.18.21.RFL,204000.
18.18.31.GET,LGOECS,NOMA730.
18.38.16.LGOECS,INPUT=NOMA730.
18.38.17. MIN FL - 67000 LOAD, 203700 EXECUTE.
18.39.39.STOP
18.39.39.ATIM     71.670 SEC.
18.39.39.CPU      37.021 SEC.
18.39.39.PPU      41.242 SEC.
18.39.39.MUCM      4.440 MWD-SEC.
18.39.39.DISK     38.872 KPRUS.
18.39.39.PRNT       2000 EST LINES.
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UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
UCG5800N. JW65705. 243761. WRCBLESKI,J. 1921 LINES. LQ20. ********************
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APPENDIX C

REPRESENTATIVE MISSION SIMULATION FOR LAUNCH-AND-RESUPPLY SHUTTLE MODE

```
*********************************
*SATELLITE LIFE CYCLE COST MODEL*
*********************************
```

DATE: 09/13/74.

RUN DESCRIPTION:ECS - RESUPPLY,NOM.,PAYLOAD A,1 MO.,FLY CLASS 2 FAIL

NUMBER OF SIMULATIONS: 100

FAILURE RATE K FACTOR: 1.000
(INCLUDED IN PRINTED MTBF VALUES)

```
          *****  PROCESS DESCRIPTION          *****

PROCESS   1    *** SATELLITE FLIGHT SCHEDULING          ***
  IT IS LOCATED AT POSITION  167 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 28 HAS 21 DESCRIPTORS.
        1.00,      1.00,      0.00,    730.00,      1.00,      1.00,      0.00,     14.00,      0.00,
        0.00, *99999.00, *99999.00,      0.00,      0.00,      0.00,      0.00,      0.00,      1.00,
        1.00,      0.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE    5,    2,   79,
 THE  3 OUTPUT PROCESSES ARE   32,   -1,   44,
   OUTPUT SCHEME 15 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS   2    *** SRU REPLACEMENT SCHEDULING          ***
  IT IS LOCATED AT POSITION   72 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 39 HAS 11 DESCRIPTORS.
       98.00,      0.00,    730.00, *99999.00,      4.00, *99999.00, *99999.00, *99999.00, *99999.00,
        6.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 3 INPUT PROCESSES ARE  104,  103,   42,
 THE  3 OUTPUT PROCESSES ARE   42,   30,    1,
   OUTPUT SCHEME 13 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN

PROCESS   3    *** SATELLITE CHECKOUT                  ***
  IT IS LOCATED AT POSITION  366 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
        1.00,     72.00,      0.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE    5,
 THE  1 OUTPUT PROCESSES ARE   32,
   OUTPUT SCHEME  0 IS USED
 10 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
```

```
    INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN


  PROCESS   4    *** SRU RETURN CHECKOUT                 ***
     IT IS LOCATED AT POSITION   13 OF THE INTERNAL COMPUTER LIST AREA.
    PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
           1.00,      12.00,      0.00,      0.00,
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE    5,
    THE  1 OUTPUT PROCESSES ARE   30,
      OUTPUT SCHEME  0 IS USED
     1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
    INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN


  PROCESS   5    *** PAYLOAD RETURN SEPARATION           ***
     IT IS LOCATED AT POSITION   28 OF THE INTERNAL COMPUTER LIST AREA.
    PROCESS TRANSFORMATION TYPE 25 HAS  1 DESCRIPTORS.
           0.00,
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE   13,
    THE  8 OUTPUT PROCESSES ARE    1,    3,   30,    4,    2,   15,   -1,  158,
      OUTPUT SCHEME 16 IS USED
    *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
    INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN


  PROCESS  10    *** SATELLITE ASSEMBLY/TEST             ***
     IT IS LOCATED AT POSITION  451 OF THE INTERNAL COMPUTER LIST AREA.
    PROCESS TRANSFORMATION TYPE 38 HAS 10 DESCRIPTORS.
           1.00,       .00,      0.00,      1.00,      5.00,      0.00,      0.00,      0.00,      0.00,
           0.00,
      REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
    THE 1 INPUT PROCESSES ARE   44,
    THE  1 OUTPUT PROCESSES ARE   32,
      OUTPUT SCHEME  0 IS USED
    *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
    INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
    THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS  11    *** LANDING/SAFING                              ***
   IT IS LOCATED AT POSITION  351 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
         1.00,       9.60,       0.00,       0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   52,
  THE  1 OUTPUT PROCESSES ARE   13,
    OUTPUT SCHEME  0 IS USED
   5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS  13    *** PAYLOAD REMOVAL/SHUTTLE MAINTEN. ***
   IT IS LOCATED AT POSITION  332 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 34 HAS  7 DESCRIPTORS.
         1.00,      60.80,       0.00,       1.00,      10.00,       0.00,       0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE    11,
  THE  2 OUTPUT PROCESSES ARE   19,    5,
    OUTPUT SCHEME 11 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS  15    *** SRU REWORK                                  ***
  ACTIVITY COST TRANSFORMATION  5 HAS  2 DESCRIPTORS.
      2005.00,       .06,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   IT IS LOCATED AT POSITION  547 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 46 HAS  4 DESCRIPTORS.
         1.00,        .00,       0.00,       0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE     5,
  THE  1 OUTPUT PROCESSES ARE  157,
    OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS SPECIAL
```

```
PROCESS  19    *** PREMATE PREP/PAYLOAD INSTALL      ***
   IT IS LOCATED AT POSITION  203 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 32 HAS  8 DESCRIPTORS.
       1.00,    730.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE   13,   32,   31,
  THE  1 OUTPUT PROCESSES ARE   24,
    OUTPUT SCHEME  0 IS USED
   5 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS SPECIAL

PROCESS  24    *** SHUTTLE ASSEMBLY                  ***
   IT IS LOCATED AT POSITION  381 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       1.00,      0.00,      0.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   19,
  THE  1 OUTPUT PROCESSES ARE   27,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  27    *** LAUNCH                            ***
  ACTIVITY COST TRANSFORMATION  6 HAS 13 DESCRIPTORS.
     13006.00,    264.86,   3200.00,    890.91,   3200.00,    280.00,   3200.00,   1113.64,   3200.00,
       280.00,   6000.00,   1113.64,   6000.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   IT IS LOCATED AT POSITION  396 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       1.00,      0.00,      0.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   24,
  THE  1 OUTPUT PROCESSES ARE   39,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
```

```
THE INITIAL PROCESS STATUS IS OPEN

PROCESS  30    *** SRU PAYLOAD HOLD/RELEASE          ***
   IT IS LOCATED AT POSITION   98 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 40 HAS  2 DESCRIPTORS.
         0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   42,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  2 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  31    *** DUMMY INSERT SHUTTLES             ***
   IT IS LOCATED AT POSITION  224 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
       -0.00,      -0.00,      -0.00,      -0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   -1,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  0 IS USED
   4 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  4 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS CLOSED

PROCESS  32    *** SATELLITE HOLD/RELEASE            ***
   IT IS LOCATED AT POSITION  512 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 35 HAS  5 DESCRIPTORS.
         0.00,       0.00,       0.00,       0.00,       0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE    1,    10,     3,
  THE  1 OUTPUT PROCESSES ARE   19,
   OUTPUT SCHEME  2 IS USED
  0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS  39    *** LAUNCH INTO ORBIT                        ***
   IT IS LOCATED AT POSITION  239 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 33 HAS  9 DESCRIPTORS.
       1.00,      .00,      0.00,      1.00,      0.00,      0.00,      2.00,      0.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   27,
  THE  5 OUTPUT PROCESSES ARE  199,   52,   45,   45,   45,
    OUTPUT SCHEME 10 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS  42    *** SRU REPLACEMENT                          ***
   IT IS LOCATED AT POSITION  530 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 37 HAS  5 DESCRIPTORS.
       1.00,      .00,      0.00,     -1.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE    2,
  THE  2 OUTPUT PROCESSES ARE   30,    2,
    OUTPUT SCHEME 14 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS  44    *** SPACECRAFT EQUIP. MFG                    ***
  ACTIVITY COST TRANSFORMATION  5 HAS  2 DESCRIPTORS.
     2005.00,      .64,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
   IT IS LOCATED AT POSITION  465 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 37 HAS 12 DESCRIPTORS.
       1.00,      .00,      0.00,      8.00,      1.00,      2.00,      3.00,      4.00,      5.00,
      11.00,     13.00,     21.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE    1,
  THE  1 OUTPUT PROCESSES ARE   10,
    OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS  45    *** SHUTTLE/SATELLITE DISENGAGEMENT  ***
   IT IS LOCATED AT POSITION  279 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 33 HAS 10 DESCRIPTORS.
        1.00,       .00,       0.00,       2.00,       0.00,       0.00,       3.00,       0.00,       0.00,
        0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   39,
  THE  9 OUTPUT PROCESSES ARE   52,  191,  192,   65,  192,  191,   52,   65,   66,
    OUTPUT SCHEME 10 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  52    *** RETURN FROM ORBIT                  ***
   IT IS LOCATED AT POSITION  263 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE  1 HAS  4 DESCRIPTORS.
        1.00,      8.00,      0.00,      0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 2 INPUT PROCESSES ARE   39,   45,
  THE  1 OUTPUT PROCESSES ARE   11,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  65    *** SATELLITE IN ORBIT                 ***
   IT IS LOCATED AT POSITION  126 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 36 HAS 10 DESCRIPTORS.
      67600.00,     0.00,      0.00,      1.00,      1.00,      0.00,      0.00,      0.00,      0.00,
        0.00,
    REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   45,
  THE  4 OUTPUT PROCESSES ARE   65,  190,  193,  104,
    OUTPUT SCHEME 12 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN
```

```
PROCESS  66    *** REPLACE SRU IN SPACE                    ***
   IT IS LOCATED AT POSITICN   47 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATICN TYPE 27 HAS  2 DESCRIPTORS.
         .00,      65.00,
    REFER TO THE PROCESS EXPLANATICN FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   45,
  THE  1 OUTPUT PROCESSES ARE    52,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS  79    *** GENERAL ORDER INSERTION                 ***
   IT IS LOCATED AT POSITICN  565 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATICN TYPE  1 HAS  4 DESCRIPTORS.
        0.00,      0.00,       C.CC,       0.00,
    REFER TO THE PROCESS EXPLANATICN FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   -1,
  THE  1 OUTPUT PROCESSES ARE     1,
    OUTPUT SCHEME  0 IS USED
   1 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  1 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS CLOSED

PROCESS 103    *** DECISION MAKING ACTIVITY                ***
   IT IS LOCATED AT POSITION  150 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATICN TYPE  2 HAS  4 DESCRIPTORS.
        1.00,      0.00,       C.CC,       C.CO,
    REFER TO THE PROCESS EXPLANATICN FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE  199,  191,  190,
  THE  1 OUTPUT PROCESSES ARE     2,
    OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN

PROCESS 104    *** ORBITAL OPER. PYLD                      ***
   IT IS LOCATED AT POSITICN  111 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATICN TYPE  1 HAS  4 DESCRIPTORS.
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         1.00,      0.00,      0.00,      0.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   65,
  THE  1 OUTPUT PROCESSES ARE    2,
   OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS 190    *** FAILURE  SATELLITE IN ORBIT      ***
   IT IS LOCATED AT POSITION  451 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
         5.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 3 INPUT PROCESSES ARE   65,   -1,   -1,
  THE  1 OUTPUT PROCESSES ARE  103,
   OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS 191    *** SATELLITE LOST  DISENGAGEMENT    ***
   IT IS LOCATED AT POSITION  425 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
         2.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   45,
  THE  1 OUTPUT PROCESSES ARE  103,
   OUTPUT SCHEME  0 IS USED
  *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
  INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
  THE INITIAL PROCESS STATUS IS OPEN


PROCESS 192    *** SHUTTLE LOST  DISENGAGEMENT      ***
   IT IS LOCATED AT POSITION  308 OF THE INTERNAL COMPUTER LIST AREA.
  PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
         1.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
  THE 1 INPUT PROCESSES ARE   45,
```

THE 1 OUTPUT PROCESSES ARE -1,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 193 *** END OF MISSION ***
IT IS LOCATED AT POSITION 437 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
7.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 3 INPUT PROCESSES ARE 65, -1, -1,
THE 1 OUTPUT PROCESSES ARE -1,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 197 *** COLLECTION OF RETURNS ***
IT IS LOCATED AT POSITION 60 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
7.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 15,
THE 1 OUTPUT PROCESSES ARE -1,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
INITIALLY, THERE ARE 0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 198 *** SATELLITE RETRIEVAL ***
IT IS LOCATED AT POSITION 1 OF THE INTERNAL COMPUTER LIST AREA.
PROCESS TRANSFORMATION TYPE 29 HAS 1 DESCRIPTORS.
7.00,
REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
THE 1 INPUT PROCESSES ARE 5,
THE 1 OUTPUT PROCESSES ARE -1,
OUTPUT SCHEME 0 IS USED
*0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.

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INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
THE INITIAL PROCESS STATUS IS OPEN

PROCESS 199     *** SHUTTLE LOST  LAUNCH                    ***
  IT IS LOCATED AT POSITION  320 OF THE INTERNAL COMPUTER LIST AREA.
 PROCESS TRANSFORMATION TYPE 29 HAS  1 DESCRIPTORS.
      3.00,
   REFER TO THE PROCESS EXPLANATION FOR THE MEANING OF THE ABOVE VALUES.
 THE 1 INPUT PROCESSES ARE   39,
 THE  1 OUTPUT PROCESSES ARE  103,
   OUTPUT SCHEME  0 IS USED
 *0 ITEMS CAN BE PROCESSED SIMULTANEOUSLY.
 INITIALLY, THERE ARE  0 ITEMS BEING PROCESSED.
 THE INITIAL PROCESS STATUS IS OPEN
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***** SHUTTLE/SATELLITE/UNIT     DISPOSITION AT START *****

THE      ORDER 80001 IS SCHEDULED TO LEAVE PROCESS  79 AT      0.000 HOURS.

THE SHUTTLE  *0001 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
   THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0002 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
   THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0003 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
   THERE IS NO PAYLOAD ABOARD

THE SHUTTLE  *0004 IS SCHEDULED TO LEAVE PROCESS  31 AT      0.000 HOURS.
   THERE IS NO PAYLOAD ABOARD
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***** SRU/NRU UNIT DESCRIPTION *****

SRU ---------------SOLAR ARRAY/DRIVE MODULE

MODEL 1 SRU EQUIV. 1 WEIGHT 237 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10601.03	*CCCCCC000.	1.0000	ACTIVE 1.00	*CCCCO.	AD STR	92000.00 MFG.
10603.01	1CCCCCCC00	1.0000	ACTIVE 1.00	*00000.	THER	12000.00 MFG.
10651.03	4000000	1.0000	ACTIVE 1.00	*CCCCC.	A DRIV	45000.00 MFG.
10651.03	4CCC000	1.0000	STNDBY .10	*CC000.	A DRIV	45000.00 MFG.
10652.03	220410	1.0000	ACTIVE 1.00	*CCC00.	AD ELE	30000.00 MFG.
10652.03	220410	1.0000	STNDBY .10	*0CCCO.	AD ELE	30000.00 MFG.
10631.02	288684	1.0000	ACTIVE 1.00	*0CCCO.	DI/SCU	22000.00 MFG.
10631.02	288684	1.0000	STNDBY .10	*CC0CO.	DI/SCU	22000.00 MFG.
10611.03	1176471	1.0000	ACTIVE 1.00	*00000.	AD PCU	25000.00 MFG.
10611.03	1176471	1.0000	STNDBY .10	*CCCCO.	AD PCU	25000.00 MFG.
10653.03	*CCCCC0000.	1.0000	ACTIVE 1.00	*0000C.	ARRAY	528000.00 MFG.
10691.03	*CCCCCCCC0.	1.0000	ACTIVE 1.00	*00000.	HARN	10000.00 MFG.

BUILD COST .0250 MILLION DOLLARS FACTORS MFG. 1.28 BUY 1.11

SRU -------------- ELECTRIC POWER MODULE

MODEL 2 SRU EQUIV. 1 WEIGHT 440 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10301.03	*CCCCC0000.	1.0000	ACTIVE 1.00	*0CCCO.	EP STR	19600.00 MFG.
10303.01	1CCCC0000	1.0000	ACTIVE 1.00	*000CO.	THERM	18000.00 MFG.
10311.03	400000	1.0000	ACTIVE 1.00	*CCCCO.	EP PCU	25000.00 MFG.
10311.03	400000	1.0000	STNDBY .10	*CC000.	EP PCU	25000.00 MFG.
10331.01	218341	1.0000	STNDBY .10	*00CCC.	DI/SCU	39000.00 MFG.
10331.01	218341	1.0000	ACTIVE 1.00	*CCCCO.	DI/SCU	39000.00 MFG.
10351.03	1250000	1.0000	ACTIVE 1.00	*0CC00.	PCNTRL	65800.00 MFG.
10351.03	1250000	1.0000	STNDBY .10	*CCCCC.	PCNTRL	65800.00 MFG.
20352.03	1754386	1.0000	ACTIVE 1.00	*0CCCC.	BATTS	28800.00 BUY
20352.03	1754386	1.0000	ACTIVE 1.00	*00000.	BATTS	28800.00 BUY

20352.03	1154386	1.0000	ACTIVE 1.00	*00000.	BATTS	28800.00 BUY
10391.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	17000.00 MFG.

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

SRU ------------CM*D AND DATA HANDLING MODULE

MODEL 3 SRU EQUIV. 1 WEIGHT 194 NO. OF COMP. 25

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10201.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	CD STR	19600.00 MFG.
10203.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	13900.00 MFG.
10256.02	50000000	1.0000	ACTIVE 1.00	*00000.	OMNI	20000.00 BUY
10252.02	585480	1.0000	ACTIVE 1.00	*00000.	XMTR	43000.00 BUY
10252.02	585480	1.0000	STNDBY .10	*00000.	XMTR	43000.00 BUY
10251.02	248694	1.0000	ACTIVE 1.00	*00000.	RCVR	65000.00 BUY
10251.02	248694	1.0000	ACTIVE 1.00	*00000.	RCVR	65000.00 BUY
10253.02	8333333	1.0000	ACTIVE 1.00	*00000.	DIPLXR	32000.00 BUY
10273.02	2159827	1.0000	ACTIVE 1.00	*00000.	DECOD	30000.00 MFG.
10273.02	2159827	1.0000	ACTIVE 1.00	*00000.	DECODER	30000.00 MFG.
10274.02	273823	1.0000	ACTIVE 1.00	*00000.	BUSCON	20000.00 MFG.
10274.02	273823	1.0000	STNDBY .10	*00000.	BUSCON	20000.00 MFG.
10255.02	871840	1.0000	ACTIVE 1.00	*00000.	BB ASY	12000.00 MFG.
10255.02	871840	1.0000	STNDBY .10	*00000.	BB ASY	12000.00 MFG.
10211.02	400000	1.0000	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10211.02	400000	1.0000	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10254.02	4166667	1.0000	ACTIVE 1.00	*00000.	CMBSW	6500.00 BUY
10271.02	142857	1.0000	ACTIVE 1.00	*00000.	CPU	45000.00 BUY
10271.02	142857	1.0000	STNDBY .10	*00000.	CPU	45000.00 BUY
20272.02	291630	1.0000	ACTIVE 1.00	*00000.	MEM L	35000.00 BUY
20272.02	291630	1.0000	ACTIVE 1.00	*00000.	MEM L	35000.00 BUY
20272.02	291630	1.0000	STNDBY .10	*00000.	MEM U	35000.00 BUY
10231.02	292740	1.0000	ACTIVE 1.00	*00000.	DI/SCU	22000.00 MFG.
10231.02	292740	1.0000	STNDBY .10	*00000.	DI/SCU	22000.00 MFG.
10291.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	15000.00 MFG.

BUILD COST .0900 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

SRU ------------ ATTITUDE DETERM. MODULE

MODEL 4 SRU EQUIV. 1 WEIGHT 257 NO. OF COMP. 24

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10401.03	*CCCCCCC00.	1.000C	ACTIVE 1.00	*00000.	AD STR	19600.00 MFG.
10403.01	100000000	1.0000	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
30451.02	59945	1.000C	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.0000	ACTIVE 1.00	*00000.	GRA	80000.00 BUY
30451.02	59945	1.000C	STNDBY .10	*00000.	GRA	80000.00 BUY
30451.02	59945	1.000C	STNDBY .10	*00000.	GRA	80000.00 BUY
30451.02	59945	1.000C	STNDBY .10	*00000.	GRA	80000.00 BUY
20452.01	190259	1.0000	ACTIVE 1.00	*00000.	STAR T	69000.00 BUY
20452.01	190259	1.000C	STNDBY .10	*00000.	STAR T	69000.00 BUY
20452.01	190259	1.000C	ACTIVE 1.00	*00000.	STAR T	69000.00 BUY
10453.02	714286	1.000C	ACTIVE 1.00	*00000.	MAGN	20000.00 BUY
10453.02	714286	1.000C	STNDBY .10	*00000.	MAGN	20000.00 BUY
10454.00	125C0000	1.000C	ACTIVE 1.00	*00000.	SUN	44000.00 BUY
10471.02	105263	1.0000	ACTIVE 1.00	*00000.	XFER A	27500.00 MFG.
10471.02	105263	1.000C	STNDBY .10	*00000.	XFER A	27500.00 MFG.
10472.01	105263	1.000C	ACTIVE 1.00	*00000.	XFER B	27500.00 MFG.
10472.01	105263	1.000C	STNDBY .10	*00000.	XFER B	27500.00 MFG.
10473.00	2873563	1.0000	ACTIVE 1.00	*00000.	SAF MD	7000.00 MFG.
10411.03	400000	1.000C	ACTIVE 1.00	*00000.	PCU	25000.00 MFG.
10411.03	400000	1.0000	STNDBY .10	*00000.	PCU	25000.00 MFG.
10431.02	215889	1.0000	ACTIVE 1.00	*00000.	DI/SCU	56000.00 MFG.
10431.02	215889	1.0000	STNDBY .10	*00000.	DI/SCU	56000.00 MFG.
10491.03	*00000000.	1.000C	ACTIVE 1.00	*00000.	HARN	16000.00 MFG.

BUILD COST .0900 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

C-16

SRU ------------ACTUATION MODULE

MODEL 5 SRU EQUIV. 1 WEIGHT 1270 NO. OF COMP. 21

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10501.03	*CCCCC0000.	1.0000	ACTIVE 1.00	*00000.	STRUC	24000.00 MFG.
10503.01	100000000	1.000C	ACTIVE 1.00	*00000.	THERM	18000.00 MFG.
10504.02	100000000	1.000C	ACTIVE 1.00	*00000.	PTHER	11500.00 MFG.

10551.01	6666667	1.0000	ACTIVE 1.00	*00000.	RRW	52000.00 BUY
10552.01	6666667	1.0000	ACTIVE 1.00	*00000.	PRW	52000.00 BUY
10553.01	6666667	1.0000	ACTIVE 1.00	*00000.	YRW	52000.00 BUY
10571.01	309119	1.0000	ACTIVE 1.00	*00000.	RW EL	26000.00 MFG.
10571.01	309119	1.0000	STNDBY .10	*00000.	RW EL	26000.00 MFG.
10572.01	309119	1.0000	ACTIVE 1.00	*00000.	PW EL	26000.00 MFG.
10572.01	309119	1.0000	STNDBY .10	*00000.	PW EL	26000.00 MFG.
10573.01	309119	1.0000	ACTIVE 1.00	*00000.	YW EL	26000.00 MFG.
10573.01	309119	1.0000	STNDBY .10	*00000.	YW EL	26000.00 MFG.
10554.01	10000000	1.0000	ACTIVE 1.00	*00000.	RMT	8000.00 MFG.
10555.01	10000000	1.0000	ACTIVE 1.00	*00000.	PMT	8000.00 MFG.
10556.01	10000000	1.0000	ACTIVE 1.00	*00000.	YMT	8000.00 MFG.
10574.01	370370	1.0000	ACTIVE 1.00	*00000.	MT EL	25000.00 MFG.
10531.02	215889	1.0000	ACTIVE 1.00	*00000.	DI/SCU	42000.00 MFG.
10531.02	215889	1.0000	STNDBY .10	*00000.	DI/SCU	42000.00 MFG.
10557.03	83333333	1.0000	ACTIVE 1.00	*00000.	G N2	245000.00 MFG.
10558.02	2923977	1.0000	ACTIVE 1.00	*00000.	N2H4	175000.00 MFG.
10591.03	*000000000.	1.0000	ACTIVE 1.00	*00000.	HARN	16000.00 MFG.

BUILD COST .0450 MILLION DOLLARS FACTORS MFG. 1.32 BUY 1.50

SRU -------------FIVE BAND MSS MPXR-A

MODEL 11 SRU EQUIV. 1 WEIGHT 276 NO. OF COMP. 26

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10931.01	207900	1.0000	ACTIVE 1.00	*00000.	MPXR	712000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40951.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND1	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40952.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND2	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY

40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40953.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND3	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
40954.01	1321004	1.0000	ACTIVE 1.00	*00000.	BND4	111000.00 BUY
10955.01	460405	1.0000	ACTIVE 1.00	*00000.	BND5	324000.00 BUY

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

SRU -------------WIDEBAND CDH MODULE A

MODEL 13 SRU EQUIV. 1 WEIGHT 329 NO. OF COMP. 12

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10831.01	13157895	1.0000	ACTIVE 1.00	*00000.	HSMPX	3700.00 MFG.
10832.01	677966	1.0000	ACTIVE 1.00	*00000.	DATA PROCESSOR	72000.00 MFG.
10852.01	2702703	1.0000	ACTIVE 1.00	*00000.	P AMP	18100.00 MFG.
10853.01	9615385	1.0000	ACTIVE 1.00	*00000.	ANTEN	5100.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
50854.01	26315789	1.0000	ACTIVE 1.00	*00000.	DATA CH	1900.00 MFG.
10731.01	181818	1.0000	ACTIVE 1.00	*00000.	VTR	400000.00 BUY
10731.01	181818	1.0000	STNDBY .10	*00000.	VTR	400000.00 BUY

BUILD COST .0300 MILLION DOLLARS FACTORS MFG. 1.29 BUY 1.12

NRU -------------NON-REPLACEABLE COMPONENTS

MODEL 21 SRU EQUIV. 1 WEIGHT 593 NO. OF COMP. 9

TYPE	ALPHA	BETA	CONDITION	DSGN LIFE	COMP. NAME	COST(DOLLARS)
10001.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	STRUCT	88900.00 MFG.
10002.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL STRUCTURE	287000.00 MFG.
10041.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	T RING	7600.00 MFG.
10061.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	ADAPT.	25200.00 MFG.
10071.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	MECHANISMS	16100.00 MFG.
10003.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	SC THERMAL	118000.00 MFG.
10021.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL THERMAL	233000.00 MFG.
10091.02	*000000000.	1.0000	ACTIVE 1.00	*00000.	SC HARNESS	10000.00 MFG.
10081.01	*000000000.	1.0000	ACTIVE 1.00	*00000.	PL HARNESS	10000.00 MFG.

BUILD COST .0600 MILLION DOLLARS FACTORS MFG. 1.28 BUY 1.11

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***** TIME LINE ANALYSIS DESCRIPTION *****

 THERE IS NO TIME LINE ANALYSIS INPUT
ITEM    40000004 ENTERED PROCESS    19 AT      0.000 HOURS
ITEM    30000003 ENTERED PROCESS    19 AT      0.000 HOURS
ITEM    20000002 ENTERED PROCESS    19 AT      0.000 HOURS
ITEM    10000001 ENTERED PROCESS    19 AT      0.000 HOURS
ITEM       80001 ENTERED PROCESS     1 AT      0.000 HOURS
ITEM       80001 ENTERED PROCESS     1 AT      0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
ITEM       80002 ENTERED PROCESS     1 AT      0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
ITEM       80003 ENTERED PROCESS     1 AT      0.000 HOURS AND IS SCHEDULED TO FINISH AT      0.000 HOUR
ITEM       80003 ENTERED PROCESS    32 AT      0.000 HOURS
ITEM       80002 ENTERED PROCESS    32 AT      0.000 HOURS
ITEM       80001 ENTERED PROCESS    44 AT      0.000 HOURS
ITEM *      1001 ENTERED PROCESS    44 AT      0.000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
ITEM *      2001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *      3001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *      4001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *      5001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     11001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     13001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *     21001 ENTERED PROCESS   198 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *      1001 ENTERED PROCESS     0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *    200001 ENTERED PROCESS    10 AT       .000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
ITEM *    200001 ENTERED PROCESS    32 AT       .000 HOURS
ITEM *    200001 ENTERED PROCESS    32 AT       .000 HOURS
ITEM *     80002 ENTERED PROCESS     0 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM *    200001 ENTERED PROCESS    32 AT       .000 HOURS AND IS SCHEDULED TO FINISH AT       .000 HOUR
ITEM       80003 ENTERED PROCESS    32 AT       .000 HOURS
ITEM * 40000004 ENTERED PROCESS     19 AT       .000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM *    200001 ENTERED PROCESS     5 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
ITEM * 40000004 ENTERED PROCESS     24 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM * 40000004 ENTERED PROCESS     27 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM * 40000004 ENTERED PROCESS     39 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM *    200001 ENTERED PROCESS    45 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM    40000004 ENTERED PROCESS    45 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT    730.000 HOUR
ITEM *    201001 ENTERED PROCESS    65 AT    730.000 HOURS AND IS SCHEDULED TO FINISH AT   9298.948 HOUR
      0.0         0.0    0.000000          0    9999999        0    0
    730.0         0.0    0.000000          0    9999999        0    1
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   ITEM     40000004 ENTERED PROCESS        52 AT       730.000 HOURS AND IS SCHEDULED TO FINISH AT       738.000 HOUR
   ITEM     40000004 ENTERED PROCESS        11 AT       738.000 HOURS AND IS SCHEDULED TO FINISH AT       747.600 HOUR
   ITEM     40000004 ENTERED PROCESS        13 AT       747.600 HOURS AND IS SCHEDULED TO FINISH AT       808.400 HOUR
   ITEM     40000004 ENTERED PROCESS        19 AT       808.400 HOURS
   ITEM *     201001 ENTERED PROCESS        65 AT      9298.948 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS        65 AT      9298.948 HOURS AND IS SCHEDULED TO FINISH AT      9298.948 HOUR
1.600126E+06   8.010000E+02   1.063102E+06   1.001002E+06   2.886831E+06
1.000000E+00
   ITEM        80001 ENTERED PROCESS       104 AT      9298.948 HOURS AND IS SCHEDULED TO FINISH AT      9298.948 HOUR
   ITEM        80001 ENTERED PROCESS         2 AT      9298.948 HOURS
   ITEM *     201001 ENTERED PROCESS        65 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     16957.931 HOUR
   ITEM        80001 ENTERED PROCESS        65 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
1.600126E+06   9.010000E+02   2.035203E+06   1.002003E+06   8.771921E+06
1.000000E+00
   ITEM        80001 ENTERED PROCESS       104 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80003 ENTERED PROCESS         2 AT     10558.259 HOURS
    1.6962536E+57        6.7780000E+02          2.0000000E+00          1.0000000E+00
    8.0000000E+00        9.0000000E-01
   ITEM        80001 ENTERED PROCESS         2 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM *       1002 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS         2 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM *       2002 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS         2 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM *       5002 ENTERED PROCESS        42 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
1      1600126      -60008        1063102       1001002        80001        288683      1
2            0      -80009        2035203       1002003        80001        877192      2
   ITEM        80003 ENTERED PROCESS         2 AT *10557.259 HOURS
   ITEM        80001 ENTERED PROCESS         2 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM        80001 ENTERED PROCESS        30 AT     10558.259 HOURS
   ITEM         5002 ENTERED PROCESS        30 AT     10558.259 HOURS
   ITEM         2002 ENTERED PROCESS        30 AT     10558.259 HOURS
   ITEM         1002 ENTERED PROCESS        30 AT     10558.259 HOURS
   ITEM *      80001 ENTERED PROCESS        30 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     10558.259 HOUR
   ITEM * 30000003 ENTERED PROCESS          19 AT     10558.259 HOURS AND IS SCHEDULED TO FINISH AT     11288.259 HOUR
   ITEM *      80001 ENTERED PROCESS         4 AT        -1.000 HOURS AND IS SCHEDULED TO FINISH AT        -1.000 HOUR
   ITEM * 30000003 ENTERED PROCESS          24 AT     11288.259 HOURS AND IS SCHEDULED TO FINISH AT     11288.259 HOUR
   ITEM * 30000003 ENTERED PROCESS          27 AT     11288.259 HOURS AND IS SCHEDULED TO FINISH AT     11288.259 HOUR
   ITEM * 30000003 ENTERED PROCESS          39 AT     11288.259 HOURS AND IS SCHEDULED TO FINISH AT     11288.259 HOUR
   ITEM * 30000003 ENTERED PROCESS          45 AT     11288.259 HOURS AND IS SCHEDULED TO FINISH AT     11288.260 HOUR
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   ITEM *   201C01 ENTERED PROCESS      65 AT  11288.26C HOURS AND IS SCHEDULED TO FINISH AT  16557.531 HOUR
   ITEM * 3CCC0003 ENTERED PROCESS      66 AT  11288.260 HOURS AND IS SCHEDULED TO FINISH AT  1128E.26C HOUR
   ITEM * 30000003 ENTEREC PROCESS      52 AT  11288.26C HOURS AND IS SCHEDULED TO FINISH AT  1129E.260 HOUR
   ITEM * 30C00CO3 ENTERED PROCESS      11 AT  11296.260 HOURS AND IS SCHEDULED TO FINISH AT  11305.86C HOUR
   ITEM *    80001 ENTEREC PROCESS      13 AT  11305.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.86C HOUR
   ITEM   3CCC0C03 ENTERED PROCESS      13 AT  11305.86C HOURS AND IS SCHEDULED TO FINISH AT  1136E.66C HOUR
   ITEM      80001 ENTERED PROCESS       5 AT  11315.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.86C HOUR
   ITEM *     5001 ENTERED PROCESS       5 AT  11315.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.86C HOUR
   ITEM      80001 ENTERED PROCESS       2 AT  11315.86C HOURS
   ITEM *     5001 ENTERED PROCESS      15 AT  11315.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.861 HOUR
   ITEM *     2001 ENTERED PROCESS      15 AT  11315.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.861 HOUR
   ITEM       1001 ENTERED PROCESS      15 AT  11315.860 HOURS AND IS SCHEDULED TO FINISH AT  11315.861 HOUR
   ITEM       1001 ENTERED PROCESS     197 AT  11315.861 HOURS
   ITEM       2001 ENTERED PROCESS     197 AT  11315.861 HOURS
   ITEM       5C01 ENTERED PROCESS     197 AT  11315.861 HOURS
   ITEM   30000C03 ENTERED PROCESS      19 AT  11366.660 HOURS
   ITEM *   201001 ENTERED PROCESS      65 AT  16957.931 HOURS AND IS SCHEDULED TO FINISH AT  47348.978 HOUR
   ITEM      80001 ENTERED PROCESS      65 AT  16957.931 HOURS AND IS SCHEDULED TO FINISH AT  16957.931 HOUR
1.600126E+06  1.101C00E+03  2.045201E+C6  1.C02003E+06  9.512910E+05
1.0C000CE+00
   ITEM      80001 ENTERED PROCESS     104 AT  16957.931 HOURS AND IS SCHEDULED TO FINISH AT  16957.931 HOUR
   ITEM      80001 ENTERED PROCESS       2 AT  16957.931 HOURS
   ITEM *   201001 ENTERED PROCESS      65 AT  47348.978 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
   ITEM      80001 ENTEREC PROCESS      65 AT  47348.97E HOURS AND IS SCHEDULED TO FINISH AT  47348.978 HOUR
1.600126E+C6  1.101000E+03  1.C47102E+C6  1.001002E+06  1.052631E+06
1.CC000CE+00
   ITEM      80001 ENTERED PROCESS     104 AT  47348.978 HOURS AND IS SCHEDULED TO FINISH AT  47348.978 HOUR
   ITEM      80C01 ENTERED PROCESS       2 AT  47348.978 HOURS
0    50859.6        0.0   0.CCC000         C    9999999       0    0
1       C.0    50129.6   1.C00000     50130     50130       0    1
   ITEM *   201CC1 ENTERED PROCESS      65 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  62953.243 HOUR
   ITEM      8CC01 ENTERED PROCESS      65 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
1.600126E+06  1.100000E+03  2.045201E+C6  2.002003E+06  1.000000E+00
0.
   ITEM      80001 ENTERED PROCESS     104 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
   ITEM      80003 ENTERED PROCESS       2 AT  50859.592 HOURS
    1.6962536E+57      2.572C000E+02      1.C00000E+00      1.C00000C0E+00
    7.0000000E+00      9.0C00000E-01
   ITEM      80001 ENTERED PROCESS       2 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
   ITEM      80001 ENTERED PROCESS      42 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
   ITEM *     4002 ENTEREC PROCESS      42 AT  30859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
   ITEM      80001 ENTERED PROCESS       2 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
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    ITEM      80001 ENTERED PROCESS     42 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
    ITEM *     5003 ENTERED PROCESS     42 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
 1      1600126       -70011        2045201        2002003          80001              0        1
 2            0            0        1047102        1001002              0         105263        2
    ITEM      80003 ENTERED PROCESS      2 AT *50858.592 HOURS
    ITEM      80001 ENTERED PROCESS      2 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
    ITEM      80001 ENTERED PROCESS     30 AT  50859.592 HOURS
    ITEM       5003 ENTERED PROCESS     30 AT  50859.592 HOURS
    ITEM       4002 ENTERED PROCESS     30 AT  50859.592 HOURS
    ITEM *    80001 ENTERED PROCESS     30 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  50859.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     19 AT  50859.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM *    80001 ENTERED PROCESS      3 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
    ITEM * 20000002 ENTERED PROCESS     24 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     27 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     39 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     45 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM *   201001 ENTERED PROCESS     65 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  63643.647 HOUR
 0         0.0       730.0     .014353       730        730           0     0
 1     51589.6     50129.6     .985647     50130      50130           0     1
    ITEM * 20000002 ENTERED PROCESS     66 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51589.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     52 AT  51589.592 HOURS AND IS SCHEDULED TO FINISH AT  51597.592 HOUR
    ITEM * 20000002 ENTERED PROCESS     11 AT  51597.592 HOURS AND IS SCHEDULED TO FINISH AT  51607.192 HOUR
    ITEM *    80001 ENTERED PROCESS     13 AT  51607.192 HOURS AND IS SCHEDULED TO FINISH AT  51617.192 HOUR
    ITEM   20000002 ENTERED PROCESS     13 AT  51607.192 HOURS AND IS SCHEDULED TO FINISH AT  51667.992 HOUR
    ITEM      80001 ENTERED PROCESS      5 AT  51617.192 HOURS AND IS SCHEDULED TO FINISH AT  51617.192 HOUR
    ITEM *     5002 ENTERED PROCESS      5 AT  51617.192 HOURS AND IS SCHEDULED TO FINISH AT  51617.192 HOUR
    ITEM      80001 ENTERED PROCESS      2 AT  51617.192 HOURS
    ITEM *     5002 ENTERED PROCESS     15 AT  51617.192 HOURS AND IS SCHEDULED TO FINISH AT  51617.193 HOUR
    ITEM       4001 ENTERED PROCESS     15 AT  51617.192 HOURS AND IS SCHEDULED TO FINISH AT  51617.193 HOUR
    ITEM       4001 ENTERED PROCESS    197 AT  51617.193 HOURS
    ITEM       5002 ENTERED PROCESS    197 AT  51617.193 HOURS
    ITEM   20000002 ENTERED PROCESS     19 AT  51667.992 HOURS
    ITEM *   201001 ENTERED PROCESS     65 AT  63643.647 HOURS AND IS SCHEDULED TO FINISH AT  63761.856 HOUR
    ITEM      80001 ENTERED PROCESS     65 AT  63643.647 HOURS AND IS SCHEDULED TO FINISH AT  63643.647 HOUR
1.600126E+06  2.001000E+03  3.045102E+06  1.003006E+06  9.999999E+07
1.000000E+00
    ITEM      80001 ENTERED PROCESS    104 AT  63643.647 HOURS AND IS SCHEDULED TO FINISH AT  63643.647 HOUR
    ITEM      80001 ENTERED PROCESS      2 AT  63643.647 HOURS
    ITEM *   201001 ENTERED PROCESS     65 AT  63761.856 HOURS AND IS SCHEDULED TO FINISH AT  65149.233 HOUR
    ITEM      80001 ENTERED PROCESS     65 AT  63761.856 HOURS AND IS SCHEDULED TO FINISH AT  63761.856 HOUR
1.600126E+06  2.101000E+03  1.057301E+06  1.001002E+06  3.091191E+06
1.000000E+00
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    ITEM        80C01 ENTERED PROCESS     104 AT  63761.856 HOURS AND IS SCHEDULED TO FINISH AT  63761.856 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  63761.856 HOURS
    ITEM *     201C01 ENTERED PROCESS      65 AT  65149.233 HOURS AND IS SCHEDULED TO FINISH AT  69915.148 HOUR
    ITEM        80C01 ENTERED PROCESS      65 AT  65149.233 HOURS AND IS SCHEDULED TO FINISH AT  65149.233 HOUR
1.600126E+06  2.001000E+03  1.047201E+C6  1.001002E+06  1.052631E+06
1.CC000CE+00
    ITEM        80001 ENTERED PROCESS     104 AT  65149.233 HOURS AND IS SCHEDULED TO FINISH AT  65149.233 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  65149.233 HOURS
    ITEM *     201C01 ENTERED PROCESS      65 AT  69915.148 HOURS AND IS SCHEDULED TO FINISH AT  73459.426 HOUR
    ITEM        80001 ENTERED PROCESS      65 AT  69915.148 HOURS AND IS SCHEDULED TO FINISH AT  69915.148 HOUR
1.600126E+06  2.C01000E+03  1.043102E+C6  1.001002E+06  2.158891E+06
1.CC000CE+00
    ITEM        80001 ENTERED PROCESS     104 AT  69915.148 HOURS AND IS SCHEDULED TO FINISH AT  69915.148 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  69915.148 HOURS
    ITEM *     201001 ENTERED PROCESS      65 AT  73459.426 HOURS AND IS SCHEDULED TO FINISH AT  74270.332 HOUR
    ITEM        80C01 ENTERED PROCESS      65 AT  73459.426 HOURS AND IS SCHEDULED TO FINISH AT  73459.426 HOUR
1.600126E+C6  1.401000E+03  1.073101E+C6  1.001002E+06  1.818181E+06
1.CC0000E+C0
    ITEM        80001 ENTERED PROCESS     104 AT  73459.426 HOURS AND IS SCHEDULED TO FINISH AT  73459.426 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  73459.426 HOURS
    ITEM *     201001 ENTERED PROCESS      65 AT  74270.332 HOURS AND IS SCHEDULED TO FINISH AT  75183.468 HOUR
    ITEM        80C01 ENTERED PROCESS      65 AT  74270.332 HOURS AND IS SCHEDULED TO FINISH AT  74270.332 HOUR
1.600126E+06  2.001000E+03  3.045102E+C6  2.003006E+06  9.999999E+07
1.CC00C0E+00
    ITEM        80001 ENTERED PROCESS     1C4 AT  74270.332 HOURS AND IS SCHEDULED TO FINISH AT  74270.332 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  74270.332 HOURS
    ITEM *     201001 ENTERED PROCESS      65 AT  75183.468 HOURS AND IS SCHEDULED TO FINISH AT  75567.777 HOUR
    ITEM        80001 ENTERED PROCESS      65 AT  75183.468 HOURS AND IS SCHEDULED TO FINISH AT  75183.468 HOUR
1.600126E+06  2.C01000E+03  3.045102E+C6  3.003006E+06  1.998110E+05
1.C0000CE+C0
    ITEM        80001 ENTERED PROCESS     104 AT  75183.468 HOURS AND IS SCHEDULED TO FINISH AT  75183.468 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  75183.468 HOURS
    ITEM *     201C01 ENTERED PROCESS      65 AT  75567.777 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM        80001 ENTERED PROCESS      65 AT  75567.777 HOURS AND IS SCHEDULED TO FINISH AT  75567.777 HOUR
1.600126E+06  2.C01000E+03  1.C47102E+C6  1.001002E+06  1.052631E+06
1.C0C000E+00
    ITEM        80001 ENTERED PROCESS     104 AT  75567.777 HOURS AND IS SCHEDULED TO FINISH AT  75567.777 HOUR
    ITEM        80001 ENTERED PROCESS       2 AT  75567.777 HOURS
0    75929.3        730.0     .CC970E        730         730          0     C
1        0.0      74469.3     .990292      50130       24340          0     1
    ITEM *     201C01 ENTERED PROCESS      65 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  65824.597 HOUR
    ITEM        80C01 ENTERED PROCESS      65 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
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1.600126E+06  2.000000E+03  3.045102E+06  4.003006E+06  1.000000E+00
0.
    ITEM       80001 ENTERED PROCESS    104 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80003 ENTERED PROCESS      2 AT  75929.324 HOURS
     1.6562536E+57        1.8562000E+03          3.0000000E+00        1.0000000E+00
     9.0000000E+00        9.0000000E-01
    ITEM       80001 ENTERED PROCESS      2 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM *     13002 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS      2 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM *      5004 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS      2 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM *      4003 ENTERED PROCESS     42 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
1       1600126      -50014      1073101      1001002       80001      181818      1
2             0      -50021      1057301      1001002       80001      309119      2
3             0      -90020      3045102      4003006       80001           0      3
4             0           0      1047201      1001002           0      105263      4
5             0           0      1047102      1001002           0      105263      5
6             0           0      1043102      1001002           0      215889      6
    ITEM       80003 ENTERED PROCESS      2 AT *75928.324 HOURS
    ITEM       80001 ENTERED PROCESS      2 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM       80001 ENTERED PROCESS     30 AT  75929.324 HOURS
    ITEM        4003 ENTERED PROCESS     30 AT  75929.324 HOURS
    ITEM        5004 ENTERED PROCESS     30 AT  75929.324 HOURS
    ITEM       13002 ENTERED PROCESS     30 AT  75929.324 HOURS
    ITEM *     80001 ENTERED PROCESS     30 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  75929.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      19 AT  75929.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM *     80001 ENTERED PROCESS      2 AT     -1.000 HOURS AND IS SCHEDULED TO FINISH AT     -1.000 HOUR
    ITEM * 10000001 ENTERED PROCESS      24 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      27 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      39 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      45 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM *   201001 ENTERED PROCESS      65 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  78281.928 HOUR
0         0.0      1460.0      .019228       730        730         0    0
1     76659.3     74469.3      .980772     50130      24340         0    1
    ITEM * 10000001 ENTERED PROCESS      66 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76659.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      52 AT  76659.324 HOURS AND IS SCHEDULED TO FINISH AT  76667.324 HOUR
    ITEM * 10000001 ENTERED PROCESS      11 AT  76667.324 HOURS AND IS SCHEDULED TO FINISH AT  76676.924 HOUR
    ITEM *     80001 ENTERED PROCESS     13 AT  76676.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.924 HOUR
    ITEM   10000001 ENTERED PROCESS      13 AT  76676.924 HOURS AND IS SCHEDULED TO FINISH AT  76737.724 HOUR
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   ITEM       80001 ENTERED PROCESS         5 AT  76686.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.924 HOUR
   ITEM *      4002 ENTERED PROCESS         5 AT  76686.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.924 HOUR
   ITEM       80001 ENTERED PROCESS         2 AT  76686.924 HOURS
   ITEM *      4002 ENTERED PROCESS        15 AT  76686.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.925 HOUR
   ITEM *      5003 ENTERED PROCESS        15 AT  76686.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.925 HOUR
   ITEM       13001 ENTERED PROCESS        15 AT  76686.924 HOURS AND IS SCHEDULED TO FINISH AT  76686.925 HOUR
   ITEM       13001 ENTERED PROCESS       197 AT  76686.925 HOURS
   ITEM        5003 ENTERED PROCESS       197 AT  76686.925 HOURS
   ITEM        4002 ENTERED PROCESS       197 AT  76686.925 HOURS
   ITEM    10000001 ENTERED PROCESS        19 AT  76737.724 HOURS
   ITEM *    201001 ENTERED PROCESS        65 AT  78281.928 HOURS AND IS SCHEDULED TO FINISH AT  82362.002 HOUR
   ITEM       80001 ENTERED PROCESS        65 AT  78281.928 HOURS AND IS SCHEDULED TO FINISH AT  78281.928 HOUR
1.600126E+06  2.401000E+03  3.045102E+06  1.003006E+06  9.999999E+07
1.000000E+00
   ITEM       80001 ENTERED PROCESS       104 AT  78281.928 HOURS AND IS SCHEDULED TO FINISH AT  78281.928 HOUR
   ITEM       80001 ENTERED PROCESS         2 AT  78281.928 HOURS
   ITEM *    201001 ENTERED PROCESS        65 AT  82362.002 HOURS AND IS SCHEDULED TO FINISH AT  82959.271 HOUR
   ITEM       80001 ENTERED PROCESS        65 AT  82362.002 HOURS AND IS SCHEDULED TO FINISH AT  82362.002 HOUR
1.600126E+06  2.301000E+03  1.053102E+06  1.001002E+06  2.158891E+06
1.000000E+00
   ITEM       80001 ENTERED PROCESS       104 AT  82362.002 HOURS AND IS SCHEDULED TO FINISH AT  82362.002 HOUR
   ITEM       80001 ENTERED PROCESS         2 AT  82362.002 HOURS
   ITEM *    201001 ENTERED PROCESS        65 AT  82959.271 HOURS AND IS SCHEDULED TO FINISH AT  88298.068 HOUR
   ITEM       80001 ENTERED PROCESS        65 AT  82959.271 HOURS AND IS SCHEDULED TO FINISH AT  82959.271 HOUR
1.600126E+06  2.401000E+03  2.045201E+06  1.002003E+06  9.512910E+05
1.000000E+00
   ITEM       80001 ENTERED PROCESS       104 AT  82959.271 HOURS AND IS SCHEDULED TO FINISH AT  82959.271 HOUR
   ITEM       80001 ENTERED PROCESS         2 AT  82959.271 HOURS
   ITEM *    201001 ENTERED PROCESS        65 AT  88298.068 HOURS AND IS SCHEDULED TO FINISH AT  92963.739 HOUR
   ITEM       80001 ENTERED PROCESS        65 AT  88298.068 HOURS AND IS SCHEDULED TO FINISH AT  88298.068 HOUR
1.600126E+06  1.301000E+03  4.095301E+06  1.004006E+06  9.999999E+07
1.000000E+00
   ITEM       80001 ENTERED PROCESS       104 AT  88298.068 HOURS AND IS SCHEDULED TO FINISH AT  88298.068 HOUR
   ITEM       80001 ENTERED PROCESS         2 AT  88298.068 HOURS
   ITEM *    201001 ENTERED PROCESS       193 AT  88330.000 HOURS
```

SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	0 SAT.	SIMULATION NO.
1	0	3	98.333	1.667	1
2	0	3	97.500	2.500	2
3	0	5	97.112	2.888	3
4	0	4	98.333	1.667	4
5	0	2	99.167	.833	5
6	0	6	97.500	2.500	6
7	0	4	97.500	2.500	7
8	0	5	96.667	3.333	8
9	0	2	100.000	0.000	9
10	0	2	98.333	1.667	10
11	0	4	97.500	2.500	11
12	0	6	97.500	2.500	12
13	0	6	95.833	4.167	13
14	0	3	97.500	2.500	14
15	0	2	99.167	.833	15
16	0	2	98.333	1.667	16
17	0	2	99.167	.833	17
18	0	2	98.333	1.667	18
19	0	2	99.167	.833	19
20	0	4	98.333	1.667	20
21	0	3	98.333	1.667	21
22	0	4	98.333	1.667	22
23	0	1	99.167	.833	23
24	0	5	97.500	2.500	24
25	0	3	99.167	.833	25
26	0	3	96.893	3.107	26
27	0	3	98.333	1.667	27
28	0	5	97.500	2.500	28
29	0	4	99.167	.833	29
30	0	2	98.333	1.667	30
31	0	3	98.333	1.667	31
32	0	1	99.167	.833	32
33	0	4	96.667	3.333	33
34	0	1	99.193	.807	34
35	0	3	98.333	1.667	35

SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	0 SAT.	SIMULATION NO.
36	0	5	95.833	4.167	36
37	0	1	99.167	.833	37
38	0	4	97.500	2.500	38
39	0	8	96.667	3.333	39
40	0	4	97.500	2.500	40
41	0	4	97.500	2.500	41
42	0	2	98.333	1.667	42
43	0	2	98.333	1.667	43
44	0	6	97.500	2.500	44
45	0	1	99.167	.833	45
46	0	7	97.500	2.500	46
47	0	3	97.500	2.500	47
48	0	3	99.167	.833	48
49	0	3	97.500	2.500	49
50	0	3	99.167	.833	50
51	0	3	98.333	1.667	51
52	0	2	99.167	.833	52
53	0	5	96.667	3.333	53
54	0	5	96.667	3.333	54
55	0	3	97.500	2.500	55
56	0	2	99.167	.833	56
57	0	6	95.000	5.000	57
58	0	5	98.333	1.667	58
59	0	4	97.500	2.500	59
60	0	1	99.167	.833	60
61	0	4	99.167	.833	61
62	0	4	98.333	1.667	62
63	0	2	98.333	1.667	63
64	0	5	97.100	2.900	64
65	0	4	98.333	1.667	65
66	0	3	98.333	1.667	66
67	0	3	99.167	.833	67
68	0	3	98.333	1.667	68
69	0	6	96.667	3.333	69
70	0	1	100.000	0.000	70

SIMULATION NO.	REPLACEMENT SATELLITES	SERVICE FLIGHTS	OPERATING PERCENTAGE 1 SAT.	0 SAT.	SIMULATION NO.
71	0	3	97.500	2.500	71
72	0	5	95.833	4.167	72
73	0	4	96.667	3.333	73
74	0	4	97.500	2.500	74
75	0	6	97.500	2.500	75
76	0	3	98.333	1.667	76
77	0	1	99.167	.833	77
78	0	6	97.500	2.500	78
79	0	2	98.333	1.667	79
80	0	4	97.500	2.500	80
81	0	1	99.167	.833	81
82	0	2	99.167	.833	82
83	0	3	98.333	1.667	83
84	0	4	98.333	1.667	84
85	0	2	99.167	.833	85
86	0	4	96.667	3.333	86
87	0	3	99.167	.833	87
88	0	5	98.333	1.667	88
89	0	4	96.667	3.333	89
90	0	4	97.500	2.500	90
91	0	3	100.000	0.000	91
92	0	1	100.000	0.000	92
93	0	5	96.667	3.333	93
94	0	4	97.500	2.500	94
95	0	2	100.000	0.000	95
96	0	5	96.667	3.333	96
97	0	3	97.500	2.500	97
98	0	4	97.500	2.500	98
99	0	3	99.167	.833	99
100	0	2	98.333	1.667	100

***** AVAILABILITY *****

THERE WERE 100 MISSIONS WHICH ACCUMULATED 8760000 OPERATING HOURS IN ORBIT.

```
THERE ARE  0 SATELLITES OPERATING FOR   1.930 PERCENT OF THE TIME.
                                MINIMUM   0.00 PERCENT
                                AVERAGE   1.93 PERCENT
                                MAXIMUM   5.00 PERCENT
                     STANDARD DEVIATION   1.04 PERCENT

THERE ARE  1 SATELLITES OPERATING FOR  98.070 PERCENT OF THE TIME.
                                MINIMUM  95.00 PERCENT
                                AVERAGE  98.07 PERCENT
                                MAXIMUM 100.00 PERCENT
                     STANDARD DEVIATION   1.04 PERCENT
```

*** FRECUENCY DISTRIBUTICN OF SHUTTLE LAUNCHES REQUIRED ***

LAUNCHES	1	2	3	4	5	6	7	8	9	10
OCCURNC	0	10	19	25	23	13	8	1	1	C
NORM	0.00	.4C	.76	1.00	.92	.52	.32	.04	.04	0.00
CUM	C.CC	.10	.29	.54	.77	.90	.98	.99	1.00	1.CC
LAUNCHES	1	2	3	4	5	6	7	8	9	10

MINIMUM = 2.00

AVERAGE = 4.43

MAXIMUM = 9.00

MEDIAN = 4.00

MODE = 4.0C

STANDARD CEVIATION = 1.51

*** SHUTTLE LAUNCH TIME DISTRIBUTION ***

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED IN EACH TIME INTERVAL.

THE TOTAL TIME SPANNED IS 131400.0 HOURS.

EACH INTERVAL IS 2190.0 HOURS.

AVG. NO.	1.03	.05	.09	.05	.07	.10	.07	.12	.08	.05	.09	.07	.09	.08	.08	.14	.06	.04	.08	.16
INTERVAL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
AVG. NO.	.14	.09	.10	.07	.08	.09	.11	.12	.08	.07	.05	.18	.09	.10	.04	.11	.09	.04	.07	.10
INTERVAL	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
AVG. NO.	.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INTERVAL	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

THE MIN. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 2.00

THE AVERAGE NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 4.43

THE MAX. NUMBER OF SHUTTLE LAUNCHES REQUIRED FOR A MISSION IS 9.00

LOW ALTITUDE LAUNCHES PER MISSION

MINIMUM = 1.00
AVERAGE = 3.68
MAXIMUM = 9.00
STD DEV = 1.70

HIGH ALTITUDE LAUNCHES PER MISSION

MINIMUM = 0.00
AVERAGE = .75
MAXIMUM = 3.00
STD DEV = .77

***** SERVICE FLIGHT INITIATION STATISTICS *****

THERE IS AN AVERAGE OF 3.43 SERVICE FLIGHTS PER MISSION

100.00 PERCENT WERE DUE TO AN SRU REACHING A MANDATORY STATE

```
  0.00 PERCENT WERE IN STATE   5
  0.00 PERCENT WERE IN STATE   6
 45.48 PERCENT WERE IN STATE   7
 32.65 PERCENT WERE IN STATE   8
 21.87 PERCENT WERE IN STATE   9
```

0.00 PERCENT WERE DUE TO THE TUG WEIGHT LIMIT BEING REACHED

0.00 PERCENT WERE DUE TO THE SERVICE UNIT STORAGE LIMIT BEING REACHED

SATELLITE DOWN

```
MINIMUM =     1.00
AVERAGE =     3.43
MAXIMUM =     8.00
STD DEV =     1.51
```

TUG WEIGHT LIMIT REACHED

```
MINIMUM =     0.00
AVERAGE =     0.00
MAXIMUM =     0.00
STD DEV =     0.00
```

STORAGE LIMIT REACHED

```
MINIMUM =     0.00
AVERAGE =     0.00
MAXIMUM =     0.00
STD DEV =     0.00
```

*** SRU REPLACEMENT PER SERVICE FLIGHT DISTRIBUTION ***

BOX EQUI	1	2	3	4	5	6	7
OCCURNC	17	84	101	104	34	3	0
NORM	.16	.81	.97	1.00	.33	.03	0.00
CUM	.05	.29	.59	.89	.99	1.00	1.00
BOX EQUI	1	2	3	4	5	6	7

MINIMUM = 1.00

AVERAGE = 3.18

MAXIMUM = 6.00

MEDIAN = 3.00

MODE = 4.00

STANDARD DEVIATION = 1.09

*** SRU REPLACEMENT WEIGHT DISTRIBUTION PER SERVICE FLIGHT ***

WEIGHT	240		300		360		420		480		540		600		660		720		780	
WEIGHT		270		330		390		450		510		570		630		690		750		810
OCCURNC	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORM	0.00	.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CUM	0.00	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
WEIGHT		270		330		390		450		510		570		630		690		750		810
WEIGHT	240		300		360		420		480		540		600		660		720		780	

WEIGHT	840		900		960		1020		1080		1140		1200		1260		1320		1380	
WEIGHT		870		930		990		1050		1110		1170		1230		1290		1350		1410
OCCURNC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0
NORM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.32	0.00	0.00	0.00	0.00
CUM	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.05	.05	.05	.05	.05
WEIGHT		870		930		990		1050		1110		1170		1230		1290		1350		1410
WEIGHT	840		900		960		1020		1080		1140		1200		1260		1320		1380	

WEIGHT	1440		1500		1560		1620		1680		1740		1800		1860		1920		1980	
WEIGHT		1470		1530		1590		1650		1710		1770		1830		1890		1950		2010
OCCURNC	0	3	0	47	19	0	8	0	0	5	43	16	0	26	3	1	2	1	21	40
NORM	0.00	.06	0.00	1.00	.40	0.00	.17	0.00	0.00	.11	.91	.34	0.00	.55	.06	.02	.04	.02	.45	.85
CUM	.05	.06	.06	.20	.25	.25	.27	.27	.27	.29	.41	.46	.46	.54	.55	.55	.55	.56	.62	.73
WEIGHT		1470		1530		1590		1650		1710		1770		1830		1890		1950		2010
WEIGHT	1440		1500		1560		1620		1680		1740		1800		1860		1920		1980	

WEIGHT	2040		2100		2160		2220		2280		2340		2400		2460		2520		2580	
WEIGHT		2070		2130		2190		2250		2310		2370		2430		2490		2550		2610
OCCURNC	1	15	2	0	4	21	0	21	0	4	6	2	2	0	4	1	4	0	1	0

NORM	.02	.32	.04	0.00	.09	.45	0.00	.45	0.00	.09	.13	.04	.04	0.00	.09	.02	.09	0.00	.02	0.00
CUM	.74	.78	.79	.79	.80	.86	.86	.92	.92	.93	.95	.96	.96	.96	.97	.98	.99	.99	.99	.99

WEIGHT		2070		2130		2190		2250		2310		2370		2430		2490		2550		2610
WEIGHT	2040		2100		2160		2220		2280		2340		2400		2460		2520		2580	

WEIGHT	2640		2700		2760		
WEIGHT		2670		2730		2790	
OCCURNC	0	0	2	0	0	1	0
NORM	0.00	0.00	.04	0.00	0.00	.02	0.00
CUM	.99	.99	1.00	1.00	1.00	1.00	1.00
WEIGHT		2670		2730		2790	
WEIGHT	2640		2700		2760		

MINIMUM = 270.00

AVERAGE = 1861.49

MAXIMUM = 2790.00

MEDIAN = 1830.00

MODE = 1530.00

STANDARD DEVIATION = 324.41

*** REPLACEMENT SATELLITES MISSION FREQUENCY DISTRIBUTION ***

SATELLIT	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
SATELLIT	0	1

MINIMUM = 0.00

AVERAGE = 0.00

MAXIMUM = 0.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = 0.00

*** SRU MODELS DOWN SUMMARY ***

THERE WERE NO ENTRIES IN THE DISTRIBUTION

*** SRU MODELS REWORKED ***

SRU MOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
OCCURNC	0	72	68	167	252	343	0	0	0	0	0	146	0	46	0
RATIO	0.00	.07	.06	.15	.23	.31	0.00	0.00	0.00	0.00	0.00	.13	0.00	.04	0.00
SRU MOD	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

C-39

***** SATELLITE SERVICE VISITS *****

WEIGHT FOR 1 SATELLITES

MINIMUM = 257.20
AVERAGE = 1844.86
MAXIMUM = 2766.50
STD DEV = 323.38

*** NUMBER OF SATELLITES VISITED PER MISSION ****

NO. VIS	0	1	2
OCCURNC	0	343	0
RATIO	0.00	1.00	0.00
NO. VIS	0	1	2

***** ACTIVITY COST SUMMARY *****

ID	NAME/DESCRIPTION	START HRS *	FINISH HRS *	COST (MILLIONS OF DOLLARS) MIN	AVG	MAX	STD DEV
15	SRU REWORK	-1.0	-1.0	.229	1.785	4.915	.866
27	LAUNCH	-1.0	-1.0	4.031	14.273	29.940	5.895
44	SPACECRAFT EQUIP. MFG	-1.0	-1.0	12.275	12.275	12.275	.000
	**** ACTIVITY TOTALS ****			16.535	28.332	43.932	6.133

* TYPICAL TIME FOR 1ST ITEM ENTRY AND LAST ITEM COMPLETION FOR MISSION SIMULATION 100

*** MISSION COST (MILLIONS) ***

COST DLR	10	20	30	40	50	60
OCCURNC	0	12	54	30	4	0
NORM	0.00	.22	1.00	.56	.07	0.00
CUM	0.00	.12	.66	.96	1.00	1.00
COST DLR	10	20	30	40	50	60

MINIMUM = 20.00

AVERAGE = 32.60

MAXIMUM = 50.00

MEDIAN = 30.00

MODE = 30.00

STANDARD DEVIATION = 7.16

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 1.72
MAXIMUM = 5.00
STD DEV = .80

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4	5
OCCURNC	45	42	10	2	1	0
NORM	1.00	.93	.22	.04	.02	0.00
CUM	.45	.87	.97	.99	1.00	1.00
NO. REQ	0	1	2	3	4	5

MINIMUM = 0.00

AVERAGE = .72

MAXIMUM = 4.00

MEDIAN = 1.00

MODE = 0.00

STANDARD DEVIATION = .80

SRU MODEL NUMBER 2 - ELECTRIC POWER MODULE

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 1.68
MAXIMUM = 4.00
STD DEV = .76

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4
OCCURNC	48	38	12	2	0
NORM	1.00	.79	.25	.04	0.00
CUM	.48	.86	.98	1.00	1.00
NO. REQ	0	1	2	3	4

MINIMUM = 0.00

AVERAGE = .68

MAXIMUM = 3.00

MEDIAN = 1.00

MODE = 0.00

STANDARD DEVIATION = .76

SRU MODEL NUMBER 3 - OM≠D AND DATA HANDLING MODULE

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 2.67
MAXIMUM = 4.00
STD DEV = .85

UNITS USED TO SERVICE SATELLITES

C-44

NO. REQ	0	1	2	3	4
OCCURNC	9	31	44	16	0
NORM	.20	.70	1.00	.36	0.00
CUM	.09	.40	.84	1.00	1.00
NO. REQ	0	1	2	3	4

MINIMUM = 0.00

AVERAGE = 1.67

MAXIMUM = 3.00

MEDIAN = 2.00

MODE = 2.00

STANDARD DEVIATION = .85

SRU MODEL NUMBER 4 - ATTITUDE DETERM. MODULE

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 3.52
MAXIMUM = 7.00
STD DEV = 1.12

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4	5	6	7
OCCURNC	1	17	35	28	15	3	1	0
NORM	.03	.49	1.00	.80	.43	.09	.03	0.00
CUM	.01	.18	.53	.81	.96	.99	1.00	1.00
NO. REQ	0	1	2	3	4	5	6	7

MINIMUM = 0.00

AVERAGE = 2.52

MAXIMUM = 6.00

MEDIAN = 2.00

MODE = 2.00

STANDARD DEVIATION = 1.12

SRU MODEL NUMBER 5 - ACTUATION MODULE

UNITS MANUFACTURED

MINIMUM = 2.00
AVERAGE = 4.43
MAXIMUM = 9.00
STD DEV = 1.51

UNITS USED TO SERVICE SATELLITES

C-46

NO. REQ	0	1	2	3	4	5	6	7	8	9
OCCURNC	0	10	19	25	23	13	8	1	1	0
NORM	0.00	.40	.76	1.00	.92	.52	.32	.04	.04	0.00
CUM	0.00	.10	.29	.54	.77	.90	.98	.99	1.00	1.00
NO. REQ	0	1	2	3	4	5	6	7	8	9

MINIMUM = 1.00

AVERAGE = 3.43

MAXIMUM = 8.00

MEDIAN = 3.00

MODE = 3.00

STANDARD DEVIATION = 1.51

SRU MODEL NUMBER 11 - FIVE BAND MSS MPXR-A

UNITS MANUFACTURED

MINIMUM =	1.00
AVERAGE =	2.46
MAXIMUM =	5.00
STD DEV =	1.01

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4	5
OCCURNC	16	42	25	14	3	0
NORM	.38	1.00	.60	.33	.07	0.00
CUM	.16	.58	.83	.97	1.00	1.00
NO. REQ	0	1	2	3	4	5

MINIMUM =	0.00
AVERAGE =	1.46
MAXIMUM =	4.00
MEDIAN =	1.00
MODE =	1.00
STANDARD DEVIATION =	1.01

SRU MODEL NUMBER 13 - WIDEBAND CDH MODULE A

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 1.46
MAXIMUM = 4.00
STD DEV = .65

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1	2	3	4
OCCURNC	61	34	3	2	0
NORM	1.00	.56	.05	.03	0.00
CUM	.61	.95	.98	1.00	1.00
NO. REQ	0	1	2	3	4

MINIMUM = 0.00

AVERAGE = .46

MAXIMUM = 3.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = .65

NRU MODEL NUMBER 21 - NON-REPLACEABLE COMPONENTS

UNITS MANUFACTURED

MINIMUM = 1.00
AVERAGE = 1.00
MAXIMUM = 1.00
STD DEV = 0.00

UNITS USED TO SERVICE SATELLITES

NO. REQ	0	1
OCCURNC	100	0
NORM	1.00	0.00
CUM	1.00	1.00
NO. REQ	0	1

MINIMUM = 0.00

AVERAGE = 0.00

MAXIMUM = 0.00

MEDIAN = 0.00

MODE = 0.00

STANDARD DEVIATION = 0.00

APPENDIX D

ASSESSMENT OF ADVANCED MISSIONS

APPENDIX D

ASSESSMENT OF ADVANCED MISSIONS

1. INTRODUCTION

The body of this report has considered a basic EOS-type mission implemented with a single satellite having a single instrument. Two advanced missions have been conceived to yield more frequent coverage with two instruments:

a) A single satellite with tandem instruments operating simultaneously to image adjacent swaths

b) Two satellites, with one instrument each, with orbit positions phased to provide imaging of adjacent swaths.

Cost data for these advanced missions has been developed from the resupply/retrieval costs presented for the basic mission.

1.1 Single Satellite with Two Sensors

Costs for this mission have been derived using the following procedures:

a) The number of low flights is increased by 30 percent to account for the estimated increase in payload failure rate

b) The number of high flights is unchanged, since there are no additional failures that would prevent orbit transfer

c) The rework costs are increased by 30 percent for both retrieval and resupply

d) The spacecraft cost (new) is increased by $5 M

e) The launch vehicle payload weight is increased by 15 percent on all flights.

With groundrules a), b), and c), the revised launch costs (C_L^*) are given in terms of the original launch costs (C_L) by:

$$C_L^* = 1.15 \left(1 + \frac{0.3\eta_L}{4\eta_H + \eta_L}\right) C_L$$

where η_L is the original number of low flights and η_H is the number of high flights.

1.2 Two Satellites with One Sensor Each

For this mission, the costs have been estimated using the groundrules summarized below:

a) Rework costs and new satellite costs are doubled

b) For a retrieval maintenance approach launch, costs double

c) For resupply it is assumed that both satellites can be serviced on a single flight one half of the time.

The resupply launch costs are then the average of the costs where one satellite is serviced per flight:

$$C_L^* = 2\,C_L$$

and the costs when both satellites are serviced on a single flight

$$C_L^* = \frac{W_{FSS} + 2\,\overline{W}}{W_{FSS} + \overline{W}}\,C_L$$

where W_{FSS} = 2472 pounds and $\overline{W}$ is the average Shuttle payload on resupply flight (here taken as 1300 pounds). Then

$$\overline{C_L^*} = 1.672\,C_L$$

2. RESULTS

Figure D-1 shows the resupply and retrieval mission costs for the three mission types evaluated. For double coverage, the single-satellite/tandem-instrument approach is least costly. However, it will not provide the availability levels achievable with the dual satellite scheme.

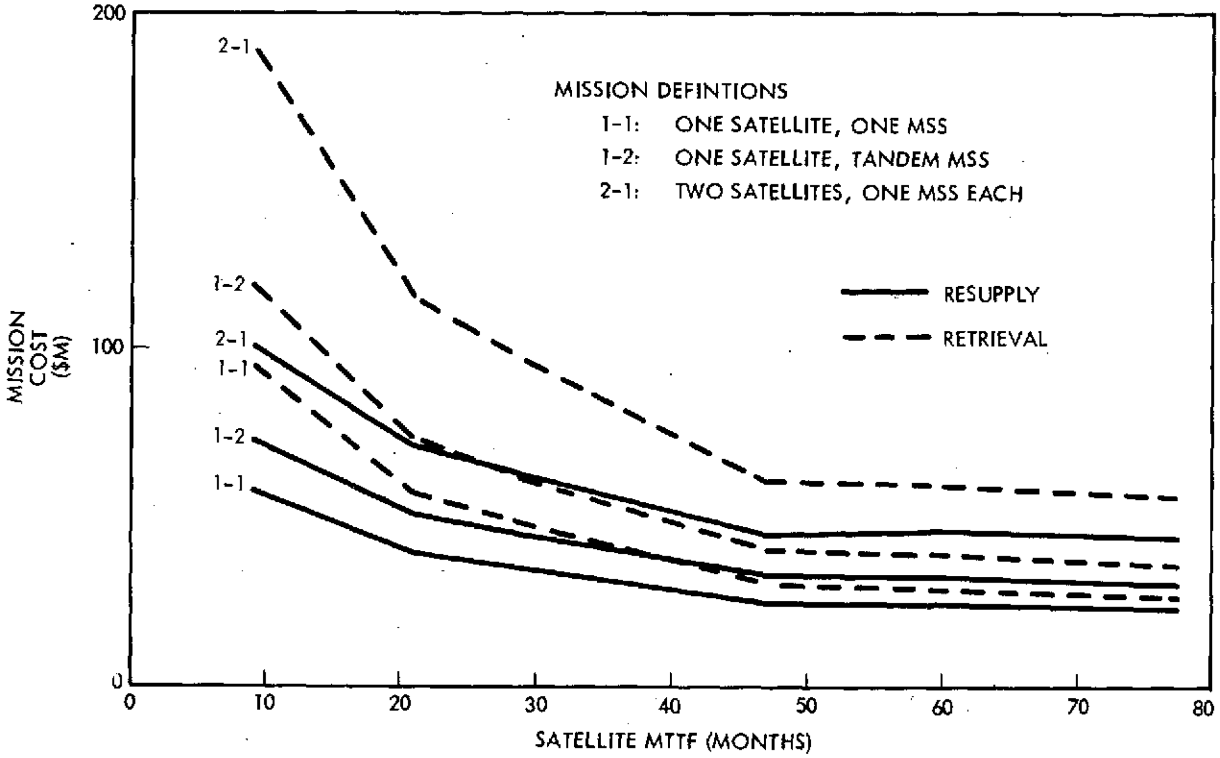

Figure D-1. Mission Costs with Servicing: Alternate Missions